Skyways

Flight Operations
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Engineering
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Management

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...er Apache
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...blems in Aviation
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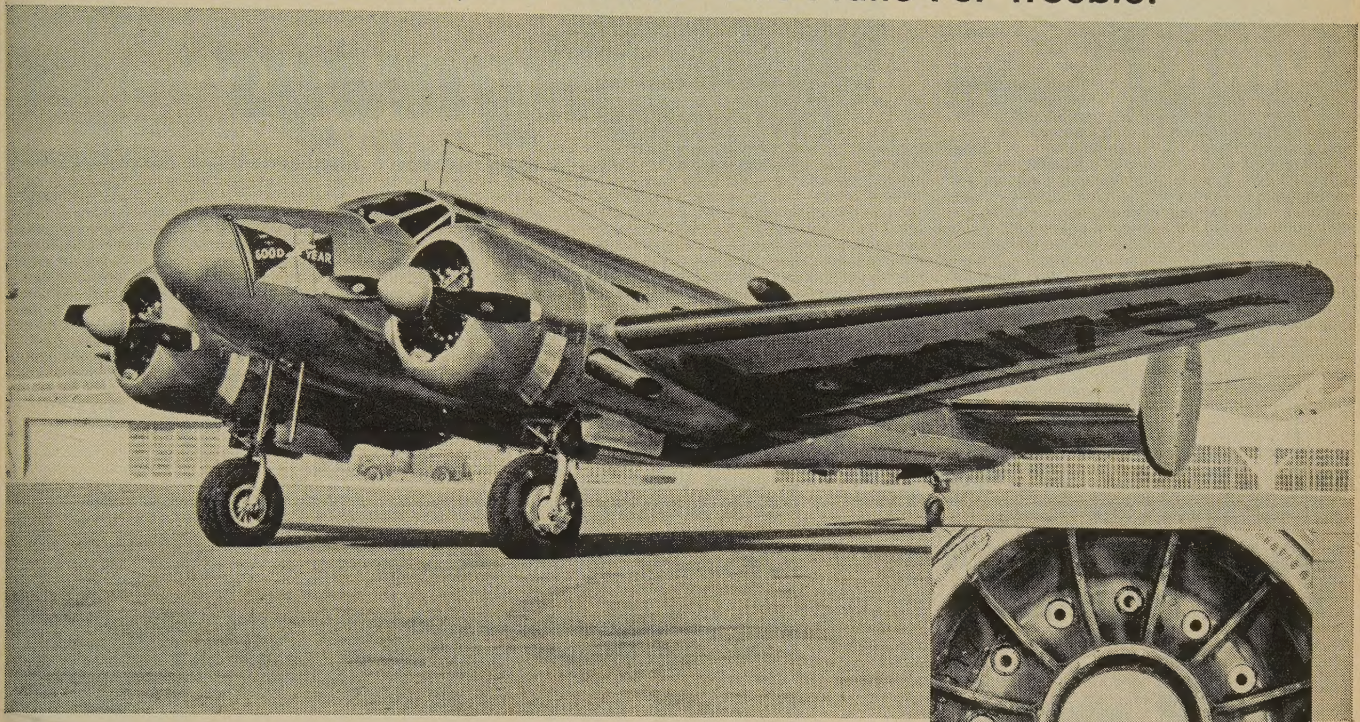
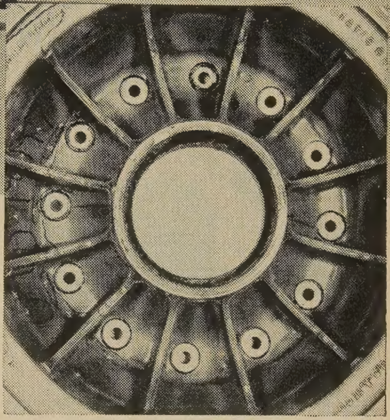
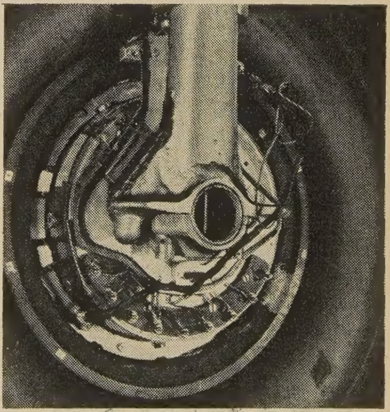
WHAT LOADS ARE ACTUALLY APPLIED ON LANDING GEARS?

—To Find Out, We "Wired" This Plane For Trouble!





First: Stresscoat for Laboratory Tests



Then: Strain Gauge Instrumentation for Comprehensive Flight Studies

IT had never been done before—an extensive *flight-test* study in which simultaneous recordings were made of all the component landing-gear loads affecting wheels and brakes, together with the resulting strain.

We selected our own Twin Beech as the guinea pig, and ultimately put it through every conceivable type of field maneuver during the course of 64 flights — *with strain gauge instrumentation of the gear at 135 points.*

But first, Stresscoat was used to tell us where to locate strain gauges. Then, to segregate loads the instrumented strut assembly was subjected to extreme conditions of drag, side, radial, and castering loads on special laboratory test equipment.

The results have proved the dependability of laboratory testing and have enabled us to go further, for they have opened up new knowledge concerning true service loads which was hitherto unknown.

It took 2 years in the doing — all because Goodyear insists on ascertaining rather than assuming the items which represent the facts of the problem, thereby helping to pioneer aviation progress.

Goodyear, Aviation Products Division, Akron 16, Ohio or Los Angeles 54, California.

GOOD YEAR
AVIATION PRODUCTS

FACILITIES + ABILITIES = EXTRA *plus* IN PERFORMANCE

JUNE, 1954

Skyways

Flight Operations • Engineering • Management

Cover: Piper Apache

FOUNDED BY J. FRED HENRY, 1942

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MORE AIRPLANE—AT YOUR PRICE

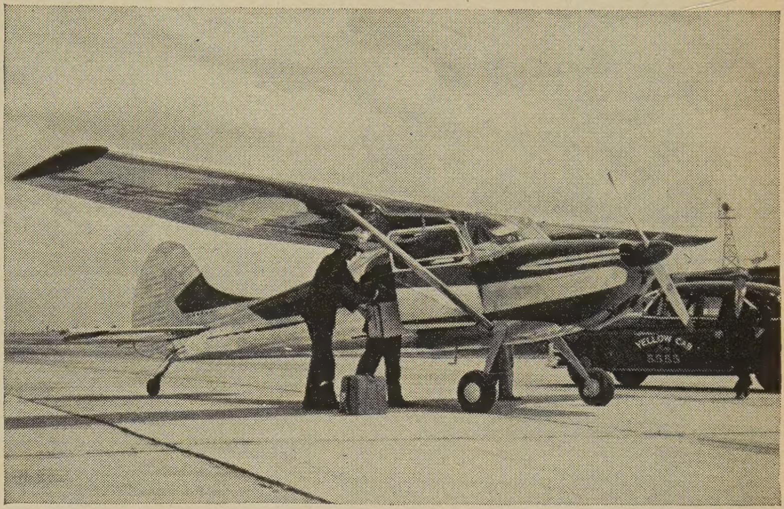
All-Metal—4-Place—Now

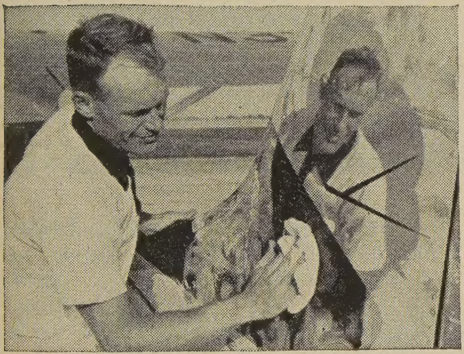
ONLY $8295

More Than Ever, Your Best Buy in the Low-Price Field!

Here it is! America's *only* 4-place, all-metal airplane in the low-price field—the beautiful 1954 Cessna 170. Eleven all-new features. Cruises at over 120 m.p.h.! Smooth, quiet 6-cylinder engine is highest-powered in low-price field. Smart new interior and exterior colors and trim. More airplane than ever . . . yet the price has been *lowered* to $8295!

170 Cessna
AIRCRAFT COMPANY





Ageless All-Metal

Cessna 170 is the only airplane in the low-price field that offers you the strength and safety of all-metal construction. Stays beautiful for years, requires no maintenance.

Only Cessna 170 Offers You These "Extra Value" Features in the Low-Price Field

"PARA-LIFT" FLAPS for short, slow landings, quick take-offs.

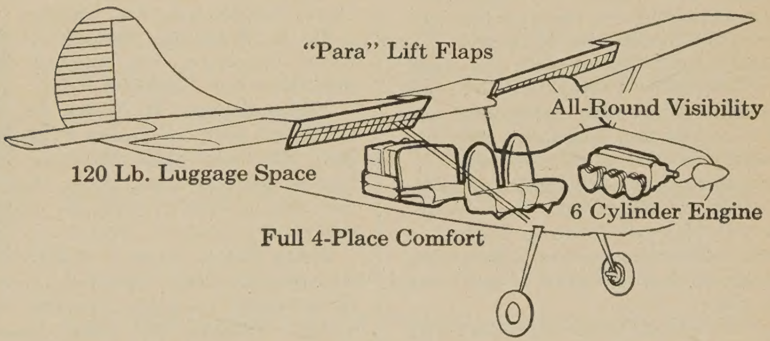
FULL 4-PLACE COMFORT with 120 lbs. luggage—or—2-place with a quarter ton of cargo.

BEST ALL-ROUND VISIBILITY . . . both over-the-nose and in flight. Compare it with any other airplane!

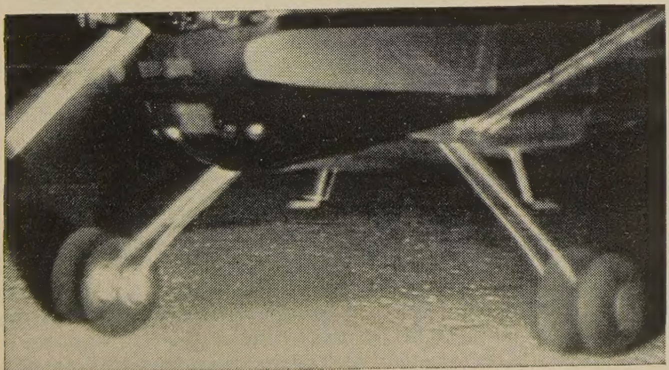
BEST HEAT and VENTILATION. Fresh warm air or fresh cool air to every passenger. Living room comfort at all altitudes, in all seasons!

6-CYLINDER ENGINE, more cylinders than any other airplane engine in the 170 price range!

ALSO: Flush-riveted wing struts . . . windshield defroster . . . easier-to-use trim tab wheel . . . improved instrument panel . . . foam-rubber seats . . . two yard-wide cabin doors.



World's Safest, Smoothest Landing Gear



It "Flexes" To Absorb Shock

Superimposed high-speed photographs show how Cessna's exclusive landing gear flexes upward and outward to absorb the shock of rough-field landings and take-offs, provides a smoother ride for passengers, reduces strain on all parts of the airplane. No maintenance is required because there are no moving parts to wear out. For more information on Cessna airplanes, see nearest Cessna dealer (listed in yellow pages of telephone book) or write Cessna Aircraft Co., Dept. S-7, Wichita, Kansas.

now hear this . . .

PERSONNEL

T. J. Ault has been named President and General Manager of the Detroit Gear Division of Borg-Warner Corporation.

D. P. Renda recently was elected vice president-legal of Western Air Lines. He heads a newly formed division of the company and is in charge of all legal proceedings, CAB cases, property contracts, lease negotiations, etc.

R. S. Gates has been named Executive Vice President of Collins Radio Company by the company's Board of Directors. At the same meeting **L. E. Bessemer** was named Vice President-Manufacturing; **R. T. Cox,** Vice President-Research & Development; **J. G. Flynn Jr.,** Vice President, Sales; and **M. W. Burrell,** Second Vice President.

Frank W. Davis recently was named chief engineer of Convair's Fort Worth Division.

Crockett A. Harrison has joined the administrative staff of Raymond P. Lansing, vice president and group executive of Bendix Aviation.

Robert Shoenhair is now assistant manager of the Washington, D. C., office of AiResearch Manufacturing Co.

William M. Beveridge, former Manager of Teterboro Airport, has been named Assistant Manager of New York International Airport. **John B. Wilson** succeeds Mr. Beveridge as Manager of Teterboro Airport.

Ford Sebastian has been elected Vice President and General Manager of the newly formed Sealectric Division of Williams Manufacturing Co., Chicago.

D. A. Peterson, formerly of Robert Hewitt Associates, has rejoined Mallard Industries, Inc., Stratford, Conn.

Major Richard H. Watts, Jr., former USAF test pilot, and **James F. Holliman,** Navy pilot, have joined Northrop Aircraft, Inc., as production test pilots. Maj. Watts also acts as military relations representative.

Keith Baker, formerly public relations manager, has been appointed assistant to the president for public relations, Chance Vought Aircraft, Inc. **John Innes** has been named public relations manager.

W. P. Bollinger has joined the Missile Section, Bendix Products Division, Bendix Aviation Corp., Mishawaka, Ind. **G. E. Wiley** has been named Manager of the Materials Dept., and **Dr. J. J. Martin** has joined the Analysis Group of the Missile Section.

Charles R. Plum recently was appointed a project manager in General Electric Company's Aircraft Accessory Turbine Dept.

C. C. Thompson has been appointed Special Consultant to the CAA. Mr. Thompson formerly was Executive Secretary of the Airport Operators Council.

Lou Davis has been named Manager of Public Relations and Advertising for the Fairchild Engine Division of Fairchild Engine and Airplane Corp.

C. M. Britt recently was elected Vice President-Sales of Southern Airways, Inc. **Norman K. Arnold** is now Vice President-Research for Southern Air-ways.

C. Merlin Wahlberg has been appointed assist. controller of Republic Aviation.

H. F. Helbig has been appointed sales engineer and is in charge of Allison Division of GM Corporation's San Diego zone office. **A. A. Adams,** sales engineer for Allison, has been transferred to the Dayton zone office.

COMPANIES

Waldick Engineering Co. recently was organized by Walter H. Dickman to represent manufacturers of aviation and industrial products on the East Coast. Offices are in Garden City, L.I., N. Y.

Trans World Airlines has signed a lease with the city of Kansas City, Mo. for an $18,000,000 overhaul base to be built at the city's new industrial airport site in Platte County.

Lear, Incorporated has expanded its East Coast sales and field office facilities with the acquisition of a new 5,000-square foot building in Westbury, Long Island, N. Y. **A. N. Lawrence** has been named eastern district manager, and **Marvin J. Parks,** assistant district manager.

Lockheed Aircraft Service, New York base, was awarded a contract for the operational overhaul of 35 Convair T-29's.

AWARDS

Dr. Roland H. Spaulding, well-known specialist in aeronautical education and vocational rehabilitation training, received an inscribed plaque from New York University for a quarter-century of service at the University.

AERO CALENDER

June 2-4—Industry inspection of NACA's Lewis Flight Propulsion Laboratory. Cleveland, Ohio.

June 5—Fifth Annual Maintenance and Operations Clinic. Reading Aviation Service, Inc., Reading Municipal Airport, Reading, Pa.

June 5-12—Second Annual Transcontinental Air Cruise sponsored by Philadelphia Junior Chamber of Commerce.

June 9-11—American Society for Quality Control, 8th Annual Convention. Jefferson Hotel, St. Louis, Mo.

June 20-23—Mid-Year Meeting, Aviation Distributors and Manufacturers Assn. Stanley Hotel, Estes Park, Colorado.

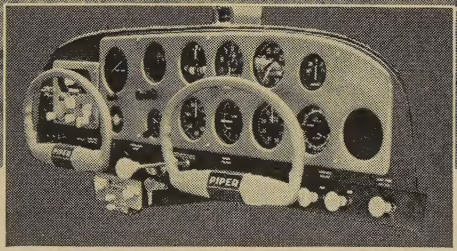
June 21-24—Annual IAS Summer Meeting, IAS Building, Los Angeles.

June 21-25—Summer and Pacific General Meeting, American Institute of Electrical Engineers. Biltmore Hotel, Los Angeles.

June 24-26—10th Annual Forum, American Helicopter Society. Mayflower Hotel, Washington, D. C.

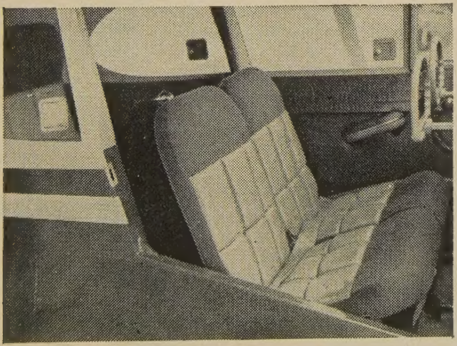
July 19-23—Annual Air Force model airplane contest. Biggs AFB, El Paso, Tex.

July 27-Aug. 5—21st National Soaring Championship Contest. Elsinore, Calif.



BUILT FOR CROSS-COUNTRY Fully-equipped Piper Super Custom costs less than most 4-place ships bare. Includes full gyro instrumentation, Omni, VHF transmitter, VHF/LF receiver, loop.

BUILT FOR PERFORMANCE Over 120 mph at better than 15 miles per gallon. The Tri-Pacer's a really useful airplane for the businessman who knows, if it's business he's after, he can go after it best by Tri-Pacer.



BUILT FOR COMFORT Foam rubber cushions assure restful riding hour after hour. Individual ventilators keep cabin cool in summer; double heaters assure warmth in coldest weather.

Piper Tri-Pacer

One thing's for sure—when you fly the Tri-Pacer you fly with confidence for you know it's *built,* really well built, really well designed. Its bridge-like fuselage, welded of high quality aircraft steel and its wings made up of aluminum spars and ribs secured by four husky lift struts, assure you of a rugged lightweight compact structure.

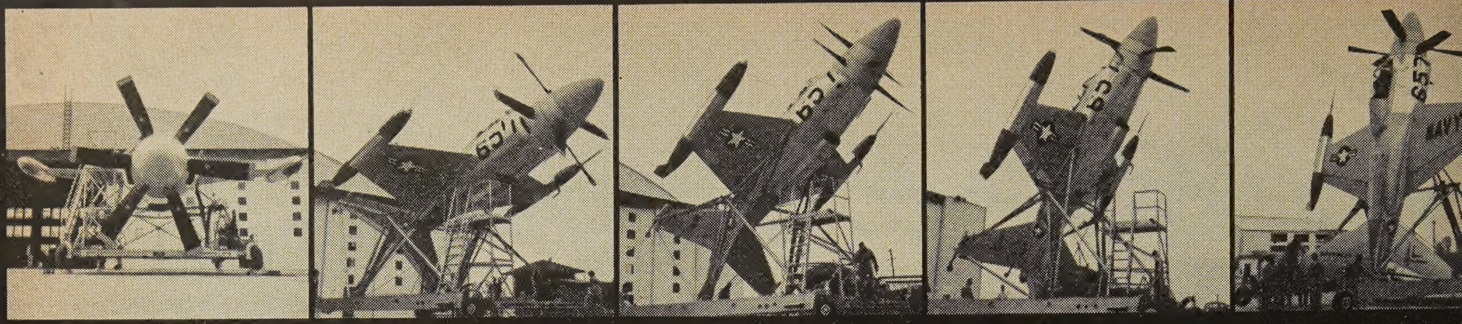
And over all is the exclusive Piper Duraclad finish, the tough plastic surface that is resilient, non-flammable, sun and weather-resistant and lasts much longer than coverings previously used. Duraclad's smooth finish means added speed and easier cleaning; comes in a choice of attractive colors.

This type of construction provides maximum strength with minimum weight which explains why the Tri-Pacer carries such a hefty load. Just another reason why more people pick Piper Tri-Pacers than any other four-place plane.

See and fly the Tri-Pacer at your Piper dealers or SEND TODAY for handsome, full-color brochure on this great airplane. Dept. 6K.

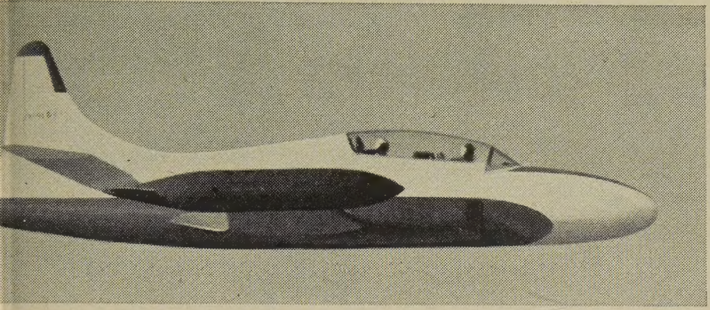
PIPER AIRCRAFT CORP.

Lock Haven • Pennsylvania

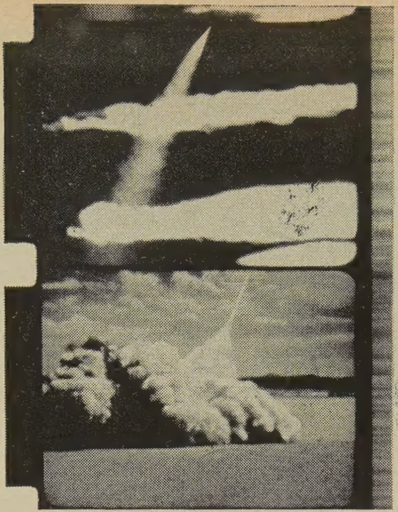


SPECIAL CRADLE LIFTS XFV-1 from prone position (for servicing) to upright for vertical takeoff.

Lockhee



D'S SAFEST JET AIRPLANE. Greater power, larger cockpit, but, above e safety have been engineered by Lockheed into its new jet trainer. New stall slats, ute, Zero Reader and pilot "stick shaker" device to automatically warn about stall are just a few of added safety features. Trainer combines jet combat perform- th maximum operational safety. Easier to fly than simple propeller-driven trainers.



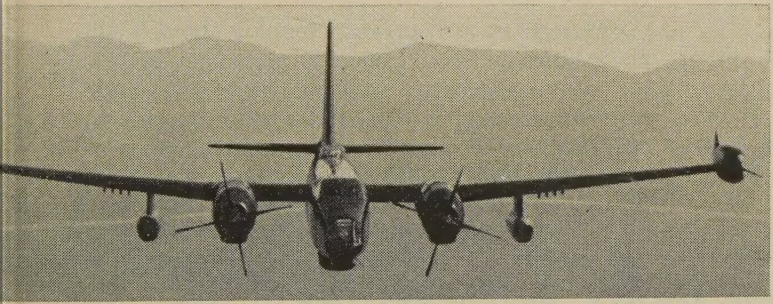
GUIDED MISSILE and pilotless aircraft research is advancing rapidly at Lockheed. Here engineer-scientists from the Missile Systems Division test top-secret developments to meet problem of supersonic speeds yet unattained.

ientists Unveil Radical Forms of Flight

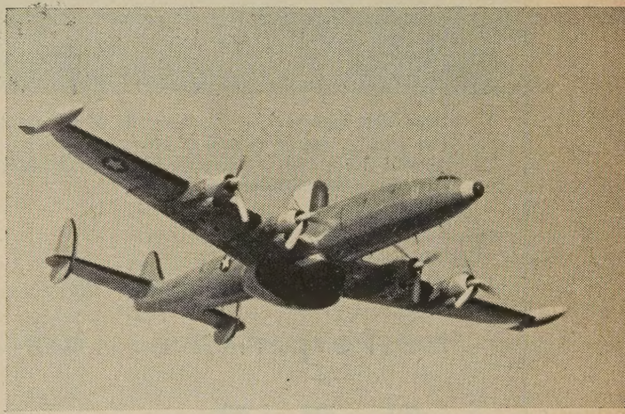
-Speed Navy Fighter Takes Off Straight Up, Lands by Backing Straight Down on Its Tail

s biggest news in aviation is the XFV-1 built by Lockheed, a rev- ary new vertical-rising plane. werful Allison turbo-prop engine vo jet turbines turning counter- propellers lifts XFV-1 straight ket fashion. It levels off for speeds 500-m.p.h. class, lands on its tail. Lockheed "firsts" are built into plane. A ¼-scale model powered by a 76-h.p. electric motor was built and flown to test vertical ascent, transition into level flight, and landing. Careful weight control permitted completion of first prototype hundreds of pounds less than estimated weight for Navy requirements.

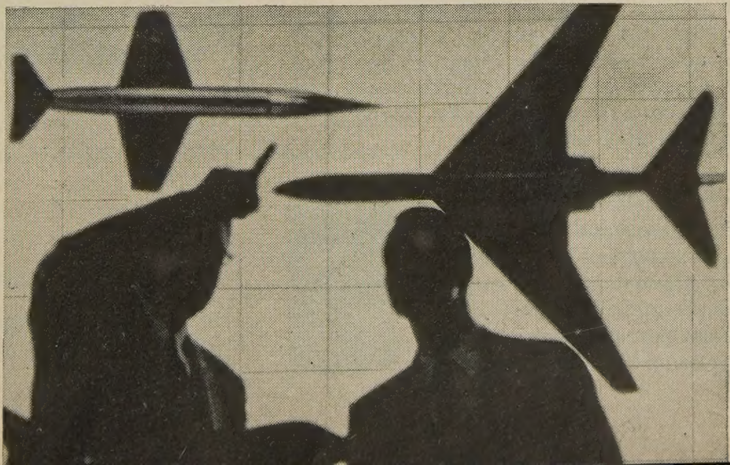
Unique 4-way tail serves as a single sur- face and jointly functions as elevator, aileron and rudder, using revolutionary interlocking controls.



D ENGINEERING pays off with Lockheed P2V Navy patrol bomber. The famous has increased gross takeoff weight and boosted speed by adding powerful jet pods. 's aerodynamic configuration, however, remains unchanged from original X model 11 through the current 7 series.



FIRST ROUND-THE-CLOCK flying radar station in the world is this Lockheed Early Warning Aircraft (designated WV-2 by Navy and RC-121C by Air Force). Huge 600-gallon tip-tanks extend radar-laden Super Constellation's range. Plane carries more scientific equipment than any other known air- craft—some six tons of electronics. Bottom radome, the size of a swimming pool, is largest plastic part ever built. Although it is held to plane by only 10 bolts (no metal ribs), radome is built to withstand aerodynamic pull of up to 60,000 pounds. Super Constellation's three-tail design insures aircraft controllability despite air-flow disturbance created by protruding radomes.



NEW FLIGHT FORMS are studied by Lockheed scien- tists to meet sonic and thermal prob- lems of ultra-high speed, higher alti- tudes. Nearly a dec- ade of research on wing shapes alone results in new Lock- heed forms in Mach 2 to Mach 3 range. Lockheed has tested almost 100 distinctly different wing mod- els on supersonic rockets.

PIPER APACHE

PIPER'S *first twin-engine transport is a four-placer in the $30,000 class for the growing executive market. It has excellent single-engine performance, despite low power, and its economy cruise range is 850 miles. Gross weight is 3500 pounds*

by Herb Fisher

Chief, Aviation Development
Port of N. Y. Authority

With the *Apache,* Piper is setting out to accomplish in the light-twin executive-transport field what it has done so successfully with its famous line of single-engine equipment —to introduce brand-new users to flying and to give old users better utility in their air transportation.

To achieve these objectives, the men of Lock Haven designed the *Apache* to a 3500-pound gross and chose the combination of Lycoming 150-hp engines and Hartzell full-feathering propellers to provide the desired single-engine, take-off and climb-out performance, and a cruising speed of 170 mph. Perhaps one of the things which makes this neat package attractive is the $30,000 price tag fluttering from Piper's modified US35B wing.

Piper claims, and it is impossible to quarrel with the statement, that few pieces of industrial equipment in this price class have ever been introduced into as ready a market as exists for the light twin-engine executive transport. The market has been there for several years, waiting for a four-placer with twin-engine reliability at the right price.

One segment of that market comprises the companies flying high-performance, single-engine, four-place aircraft. Their airplanes are good but they are essentially daylight airplanes and have no place in the air under IFR conditions. Some of these companies have made the jump to currently available twins—the Beechcrafts, Lockheeds, and Aero *Commanders*—but a majority can't afford the $45,000 or more outlay for such craft. And, of course, many companies can't absorb the relatively high operating costs of aircraft ranging from six to 14-place in accomodations.

Another segment of the market for which the *Apache* was developed includes those companies which have needed a company airplane for some time, but which shy away from the initial cost of twin-engine equipment already on the market and won't have anything to do with a single-engine airplane.

Into still a third category fall the larger companies with fleets that are comprised of a DC-3, several Twin Beechcrafts and a *Lodestar* or two. The *Apache* will be a highly useful air transport for second-line personnel in such companies, and for the shorter trips which must be made economically. The *Apache* has the additional advantage of being able to get into and out of small airports that would put a tight squeeze on an aircraft the size of the DC-3.

Until now, the business-aircraft market has been in dire need of two distinct types of aircraft. One is the heavy twin that will accommodate eight to 10 persons and transport them wherever they want to go at 300 mph or better. Many potential customers for his big twin also want pressurization, according to a survey conducted by National Business Aircraft Association. NBAA is still trying to get such an aircraft off the drawing boards and into the factory, but the problem of financing the prototype remains a big stumbling block. The other type of aircraft needed by business operators is the light twin, and Piper is helping to fill that need with the *Apache.*

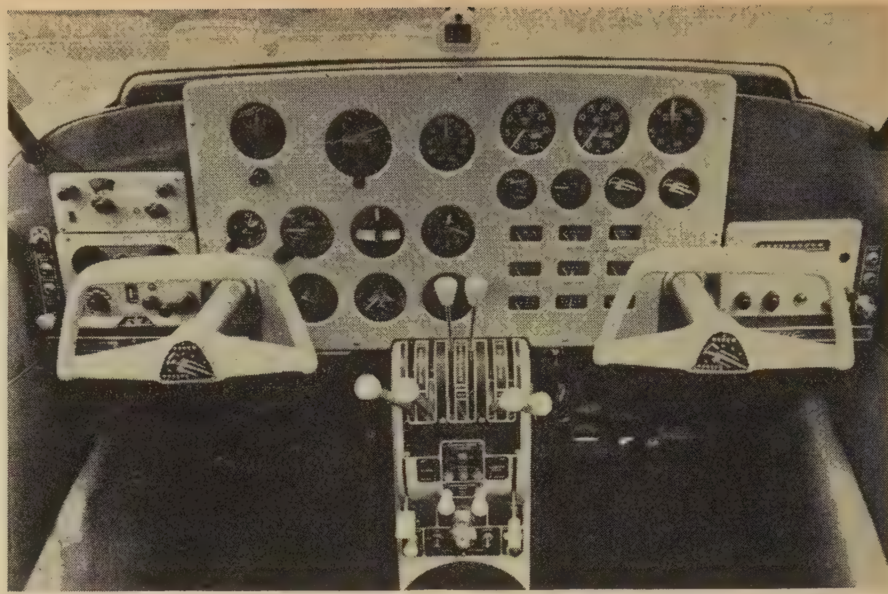
Piper took a long look at the executive market more than three years ago and decided to help build it from the bottom up rather than from

the top down. The Piper family, Walter Jamouneau, chief engineer, and J. Willard Miller, sales manager, set their sights on an aircraft which, in size, weight, load capacity, performance and cost, would be not too far away from existing so-called luxury four-placers.

To indicate how well they have succeeded in meeting those general specifications, let's switch to a point on the map just northwest of Lock Haven, Pa. We were at 6,000 feet. I was in the lefthand seat and Howard Piper occupied the right. The *Apache's* instruments told me: MP, 23 inches; RPM, 2,150; OAT, 32°; IAS, 155. We trued out at 169 mph. We carried a gross on that flight of about 3,060 pounds and were pulling less than 65% of power from the Lycomings. Howard figured we were then getting about 97 hp per engine.

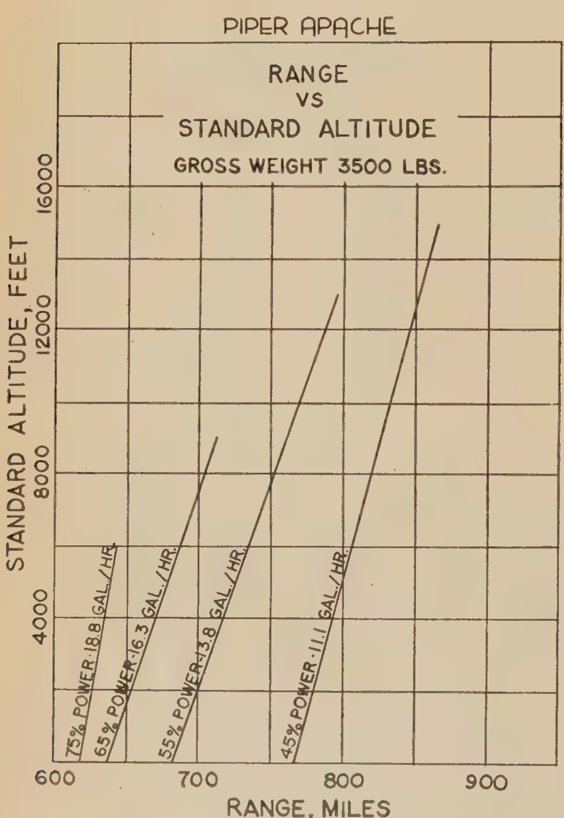
Speaking of the engines, Piper waited for Lycoming to complete development work on its new four-cylinder, 320 cubic-inch powerplant because its engineers wanted the excellent ratio of power to weight they offered and because they were rated just right for the *Apache* configuration.

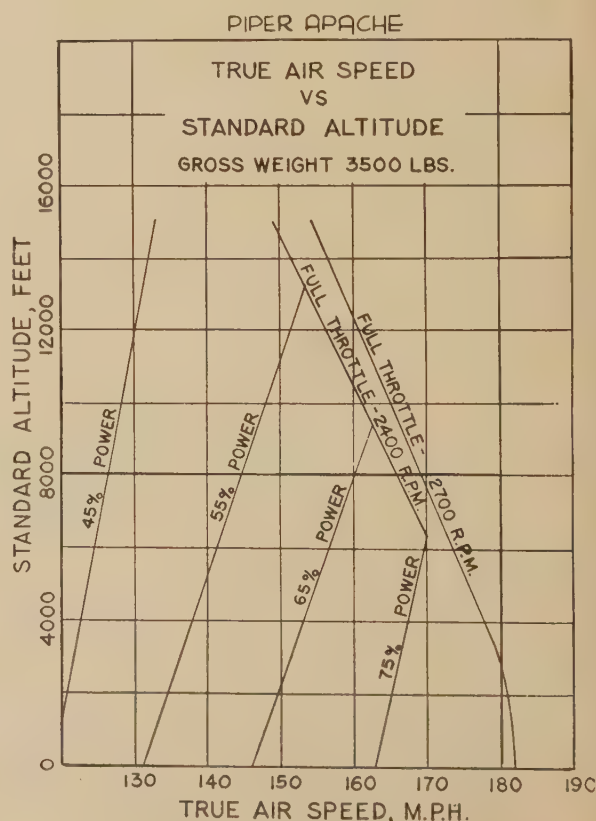
The Piper-developed cross-over system and the exhaust agumenter arrangement are combined in the exhaust system used on the *Apache's* engines. The cross-over tubes empty into single exhaust augmenter tubes situated on the outboard side of the engines underneath the wings. In that way, exhaust noises are as far away from the cabin area as possible. A low-drag, efficient cooling arrangement is created because cooling air for the engines is pumped by the jet action of the exhaust.

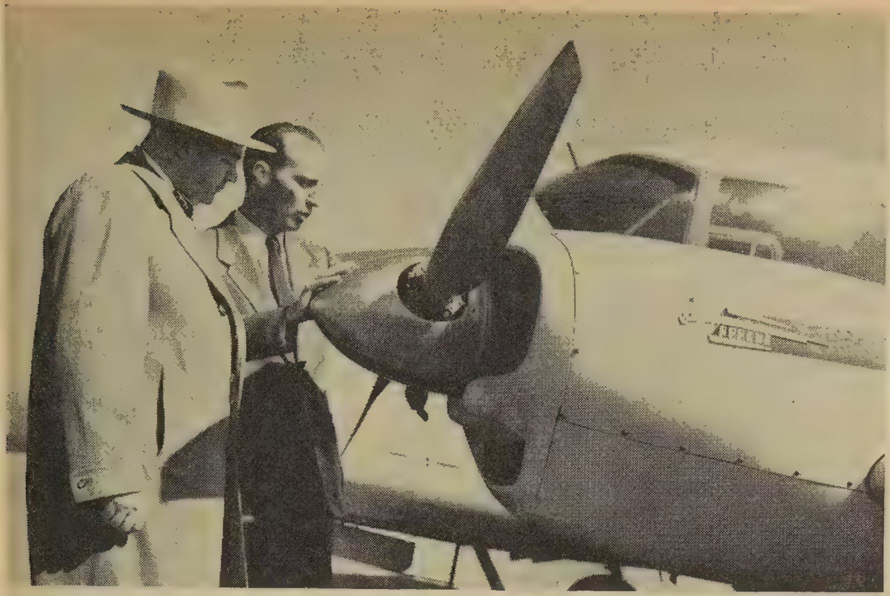


BASIC *model of the Apache has no radio equipment, but the Custom and Super models have more than the standard complement. The Super will include autopilot*

For a small twin with relatively low power, the *Apache* has what is usually difficult to achieve in this type of aircraft—dependable single-engine performance. It has an effective ceiling of 6,750 ft. with full gross and 9,500 ft. with what Piper terms "average flight" load. These single-engine figures and those that follow are based on new Piper computations and revise upward data on page 11 charts. And it is interesting to note here that maximum gross on the *Apache* has been established a bit higher than is common practice. Reason: Less clamor and tumult about insufficient gross weight. Piper anticipates that few persons ever will







PILOT *Herb Fisher and Howard Piper (right) study the Hartzell full-feathering prop installation on the Lycoming 150-hp engine before take-off from Lock Haven airport*

load the *Apache* to full allowable gross. For true performance, the graphs should be read for performance at varying weights—from 2700 to 3500 pounds.

My notes show that, while cruising at 4,000 feet with one prop feathered, the *Apache* indicated 115 mph at about 65 percent of power. TAS read about 120 mph. That is nice performance in a small airplane and is a tribute to engineering which settled on the proper combination of high-lift wing section, engine and propeller.

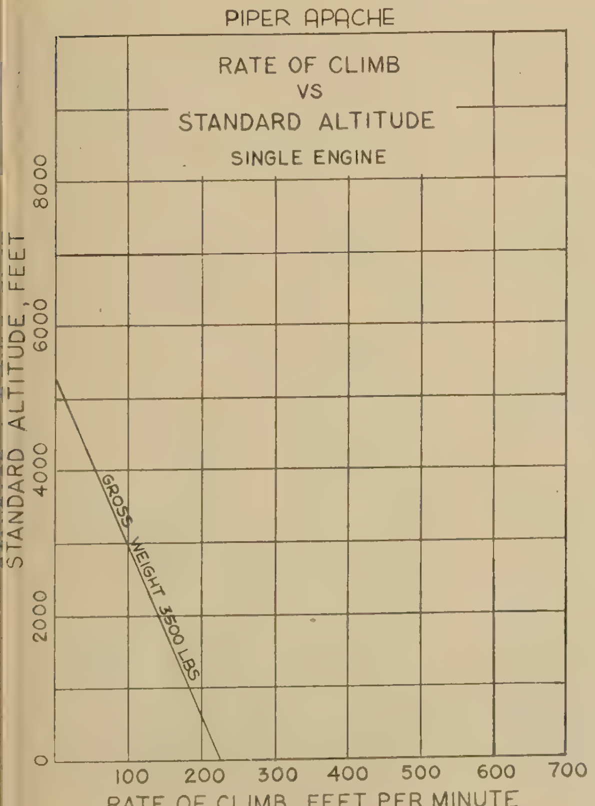
The published stalling speed of the *Apache* is 59 mph, and I found that stall recoveries are smooth. At altitude with power on, I stalled it out at 50 mph with 50% flaps. With full flaps and power off, the *Apache* stalled at around 60 mph. Any stall in the *Apache* is telegraphed by the buffeting that precedes it.

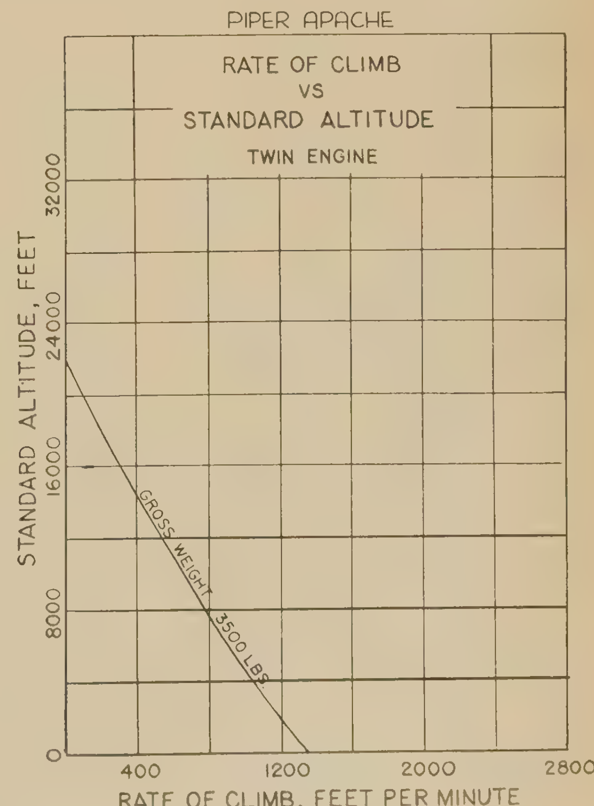
Our first take-off at Lock Haven was at 2700 rpm and the *Apache* climbed out at between 1200 and 1300 fpm. Later, I held it back to 2100 rpm on take-off and we were up just as the needle passed the 68-mph mark. The *Apache's* rate of climb at maximum gross is 1,350 fpm and on one engine at the same 3500 gross it will climb out at 240 fpm. Its single-engine rate of climb at 2900 lbs. is 400 fpm.

Piper obviously had a problem of weight control with the *Apache*, because the company wanted to include in the basic airplane many pieces of equipment not normally tagged as standard. At the same time, there was no desire to burden the airplane with unnecessary equipment. The result is an empty weight of 2,170 pounds and an airplane equipped with instruments and three radios.

As in the past, Piper is offering the *Apache* in three models. The Standard has no radio equipment and is available for those who want to install their own communications and navigation gear. The Custom model will have the radio equipment expected to be needed by most users —a Lear ADF, a Narco Omnigator for omni navigation and secondary communications, and a Narco Simplexer for primary communications. This combination provides one LF receiver and ADF; two VHF receivers, one with omni and the other with a tuning frequency locator; two

(Continued on Page 59)





TIME CARDS, *assigned to direct and indirect labor personnel paid on an hourly basis, should show date and time the work was started on a particular phase of overhaul project, and also the time work was completed. This is vital to cost control*

Timekeeping and Labor Distribution in Overhaul

by Willis L. Nye

In the quest of minimum costs for the overhaul of business aircraft, progress can be made by a proper concept of timekeeping and labor distribution costs. In a previous article ("Labor Costs in Transport Overhaul", March issue), the writer dwelled on the various phases of labor expenditure and the definition of labor costs. As a supplement to this discussion of labor costs, we must also consider timekeeping and the method employed by the overhaul base to account for the expenditure of labor and parts of any kind on a specific corporate aircraft.

Knowledge of this will assist the auditing of costs at the conclusion of the overhaul project.

Accounting Methods

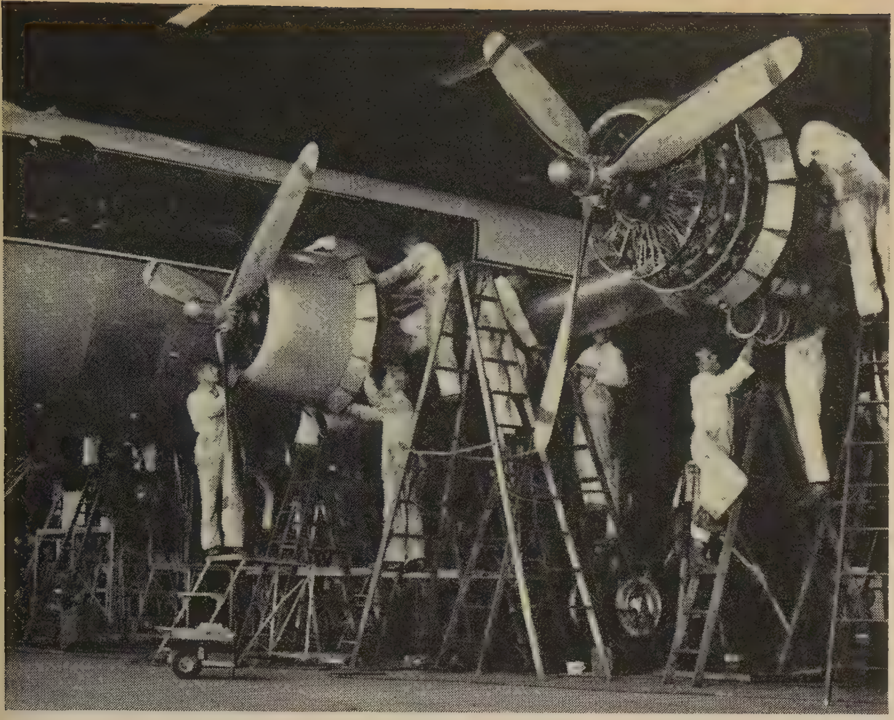
In order to properly audit the costs of an overhaul project on a large corporate aircraft, we must have a basic knowledge of how the contractor for this work accounts for the expenditure of labor and materials. At some bases, IBM or machine bookkeeping methods are used, whereas at other bases conventional accounting methods by hand are used. There is nothing to be gained by use of one method or the other, except that the machine method is faster. The auditing of final costs by the customer's representative should not be made until some understanding of how these costs are derived and distributed is obtained by the auditor performing the work.

Project Work Order

The corporate owner's representative should not place an order for overhaul work until a project number or planning order has been formally established by the contractor. This work order is the master order against which all charges for labor or parts can be identified. The breakdown of various work operations or the expenditure for spare parts for reinstallation or repair should be coded as a dash number against the master work or planning order number. The key to the audit of costs will be the daily time cards for expenditure of labor, the requisitions for direct and indirect parts and material, and the production work orders. If this form of record is not available or is not used, be assured as a corporate or private plane owner that you assume the risk of high costs to perform plane overhaul or repair.

Labor Time Cards

At overhaul bases, shop labor should punch two kinds of time cards, the first card is termed an attendance card and the second card is called the work card. The work card and the attendance card should correspond in the total daily time expended by each shop employee. Where the attendance card and item card are combined, there is much source for error in the distribution of direct and indirect labor time. In the latter method, the distribution of



SUPPLEMENT *to the master work-order number is the dash number to cover the major basic work such as overhaul, sheet metal work, tank sealing instruments, on the aircraft*

time is left to the personnel performing the work. In the first method where a work card is used, this must be authenticated by supervisory personnel and it provides a closer check on labor and parts costs. On time and material corporate projects, both cards should be audited. A close control of costs is possible by accurate auditing.

Thus, it is rational to assume that close control of labor costs and the distribution of these costs require use of certain fundamental methods of accounting. Prior to placing an order to overhaul an airplane, the shrewd business-plane owner will do well to investigate this phase of cost control.

Daily time cards should be kept in convenient racks adjacent to the timekeeper's office at the overhaul base. Each direct or indirect labor personnel paid on an hourly basis should be assigned a time card, and this card should be available for audit by the corporate owner's representative at all times. Each worker assigned to the project should show, by means of his time card, the date and time the work was started on a particular part of the project, and also the date and time the work was completed. This can be done either by pencil or by means of a portable table-type time clock where the worker punches in the time a specific job was started and the time it was completed.

The work time card should show all of the essential information—the employee's name, clock number, department number, shift, rate of compensation, day, month, year, etc., and other information deemed necessary to obtain labor costs. Where hand bookkeeping methods are used, such information may be coded so a modicum of confidential information is possible, or where machine bookkeeping methods are used, by means of a pre-punched work card. All labor expended against a specific plane project should be coded to the master work order and a sub-number under which the distribution of labor is obtainable. At the termination of each working shift, the employee signs the time card, authenticating the fact that the specific work assignments described on the work time card have been performed. This data is checked by the timekeeper, and is then countersigned by the supervisor in charge. The daily work time card is then turned into the accounting office and the basic information accounted. In the case of machine bookkeeping, the pre-punched cards are run through the automatic sorting machines, or new cards for performing this function are punched so that it can be done accordingly. Thus, two important means are available for checking labor costs for accuracy. After this distribution of labor has been made, the final accounting may be made. Whether hand or machine accounting methods are used, the corporate owner should insist on accurate cost information to keep expenditures at a minimum.

Compilation of Labor Charges

It should be emphasized that mechanical personnel are not bookkeepers and they should not be required to keep any account of the way their labor expenditures are distributed, except by punching the time clock when they start and stop a specific operation. Timekeepers should continually police the time card racks to analyze the assignment of work orders so that errors do not occur. This is essential to control costs. After all, any cost data obtained is no better than the accuracy at the source or the method in use. Where ineffective timekeeping methods are in use, considerable distortion of labor distribution will occur, providing inaccurate or exorbitant costs. Before placing a contract with any overhaul base, an examination of the base's method of cost analysis and labor distribution is recommended to prevent excess costs. Frequently, where several projects for different customers are underway at an overhaul facility, poor or inefficient timekeeping methods may cause errors. One customer may be charged for work that should have been charged to some other airplane. Even on flat-rate contract work, it is well to audit costs to assure accuracy.

Labor Distribution

As stated before, each plane project should be assigned a master work-order number. As a supplement to the master work-order number, a dash number should be assigned to cover the major basic work, *i.e.* sheet metal work, engine overhaul, tank sealing, instruments, etc. This can be further broken down by subordinate dash numbers to the prime dash number. For example, the basic master work order may be 4000. The prime dash number for sheet metal work may be 27. The subordinate dash number for wing spar and integral fuel tank sealing may be 6.Thus, to provide for a distribution of labor, the time card should be punched 4000-27-6. It is, therefore, possible to obtain a daily coding and a distribution of the work expended against a certain work order, and from this data the progress and cost of each day's work may be derived.

Normally, the dash numbers encompass integral work operations performed during the overhaul operation and are sub-divided into blocks of numbers which are assigned to each functional system of the airplane or primary structural assembly such as wings, tail, landing gear, etc. Where special work in addition to the original master work order must

be performed, other dash numbers are usually assigned to cover various repair operations when it is desirable that these be segregated. By the assignment of blocks of numbers to each functional system, rapid identification of labor-distribution charges is possible. In addition, certain shop overhead costs may be assigned specific dash numbers for allocation purposes against a specific project, such as indirect labor expenditure or indirect material allocation.

Further, proper time-card control of labor allocation will reveal whether the overhaul work has been performed on the airplane or in the overhaul shops. This is necessary because individual mechanics may be transferred around the overhaul facility. The shop number should be shown as well as the shop to which the mechanic's transfer was made. This makes it possible to control the distribution of labor between airframe and airframe components.

TIME-CARD CONTROL *of labor allocation will reveal whether the work has been performed on the airplane itself in the hangar or on a specific component part in the overhaul shop*

Direct or Indirect Materials

Direct material is defined as overhaul spares, fabricated parts, and raw materials. This should be drawn off the stock room by a coded requisition against the master work order.

The numbered requisitions should be assigned as a block to the specific plane project and a duplicate given to the customer's auditor.

The price of each part should be shown, and each requisition issued during each work period should be priced against the project for auditing purposes. Indirect material such as cleaning materials, paint, lacquer, solvents, rivets, nuts, tape, etc., for which it is impossible to accurately account should be prorated on a basis of the direct man-hours expended on the project. This percentage should be negotiated with the customer prior to the execution of the work.

When mechanics draw material from the stock room, the requisition should be authenticated by the supervisor in charge, plus the stock room clerk. The prime dash number and subordinate dash number should be shown on the requisition so that direct material allocation is also possible for auditing purposes.

Extra Work on Contracts

Where extra work is desired to be completed after the contract or purchase order has been made, this should be covered by the issuance of another work order, preferably as another dash number of the basic master work order. Time and material usually comprise the basis of cost on extra work, although on occasion, flat-rate prices may be submitted to the customer for approval. In short, such work should be negotiated, but proper segregation from the main contract work should be made mandatory. Direct, indirect materials and labor should be accountable to the auditing personnel.

Supervision Overhead Costs

At most air-transport overhaul facilities, supervisory personnel are considered to be on a productive status although their salaries are absorbed as part of overhead administrative costs. However, the allocation of these costs should be negotiated before finalizing an overhaul contract.

Inspection Personnel

At most air-transport overhaul facilities, inspection personnel are considered to be actually a part of productive labor and are compensated on an hourly rate. Their time is charged on the time cards as direct labor.

Premium Labor Time

It is obvious that to comply with a working schedule, if the progress of the work shows a lag, an expenditure must be made for overtime work. Before such work is authorized, the funds to compensate for this premium labor time should be approved by the customer on a time-and-material contract; or the overhaul facility should agree to absorb such costs for its failure to comply with their preplanned working schedule. In short, no overtime should be necessary unless approved in advance. Where overtime is worked, remember that supporting indirect labor facilities must also be available and that a proportionate percentage of indirect material must also be paid for. Because the overhaul cost increases when overtime is worked, remember that a proportionate increase in administrative cost also will be chargeable on a cost-plus contract.

Summary

The fundamentals of good timekeeping are applicable to corporate-plane overhaul as well as any other phase of plane operation. Make certain that the auditors understand these factors and that they also understand the method of timekeeping and work-order systems used at the overhaul facilities before placement of a contract for plane overhaul. A fundamental knowledge of these factors is sometimes overlooked, and to the amazement of the customer, his plane repair costs soar beyond reasonable limits. It is also advisable to make certain that the overhaul facility has a good workable system of timekeeping, production planning entirely competent accounting methods and personnel, and materials cost analysis.

by Edward T. Martin
Supt.-Training, Flight Safety, Inc.

GROUND EFFECT on the Power-Required Curve

In a previous article entitled "Flight on the Back Side of The Power Required Curve" (*March* issue), reference was made to the phenomenon known as ground effect, also called the ground cushion effect on an airfoil. Technical consideration of ground effect was avoided in the previous article in order to simplify the topic discussion. However, the study of ground effect is a most interesting aeronautical subject with a number of applications, and is a practical condition of flight with which every pilot is familiar.

Every pilot knows that ground effect helps an aircraft to become airborne more readily on take-off, and that during the landing flareout it tends to prolong the settling of the aircraft to the runway, sometimes resulting in considerable floating before contact with the ground.

Long before man ever tried his wings, birds took advantage of the benefits of ground effect in their flight. Who among us has not observed how the sea birds quite often fly in a manner just skimming the ocean surface? In their long-range flights it is possible to expend less energy for a given distance by flying close to the surface, which in turn results in greater range for a given amount of bird energy output.

In order to thoroughly understand ground effect on an airplane wing, it is necessary to consider the airfoil and the forces which act upon it as it moves through the air. We know that as a wing passes through the air a lift force as well as a drag force are generated. The lift is opposed by the weight, and the drag must be balanced by the thrust generated by the power-producing element driving the wing through the air.

Lift and drag coefficients for various airfoils are determined experimentally through wind-tunnel tests and are plotted as shown on the solid lines of *Figure 1*, which shows *Cl* and *Cd* plotted against angle of attack of the wing.

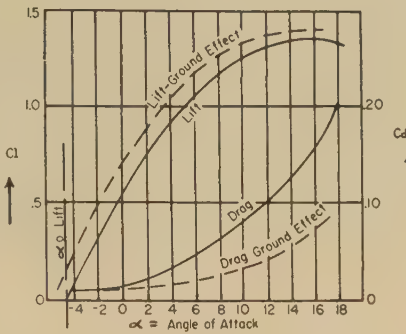


FIGURE 1

The solid lines are those for a wing aspect ratio of 6, *i.e.* the ratio of the span to chord of the wing, and are the values obtained experimentally from a wing removed from a ground boundary. From these curves the lift and drag forces can be computed readily for a wing operating at a given angle of attack, where the air density, wing area, and velocity are known, and shown respectively in the formulas below.

$$Lift = Cl\rho\frac{SV^2}{2}$$

$$Drag = Cd\rho\frac{SV^2}{2}$$

From flight experience we might suspect that a wing operating near the ground would gain in lifting power and possibly have a reduction in drag due to the cushioning effect of the air between the wing and ground. This has been proven experimentally in the wind tunnel. Wind-tunnel tests have shown that the increase in lift coefficient and decrease in drag coefficient follow somewhat as shown on the dotted lines shown in *Figure 1*. It has been shown experimentally that *L/D* ratios can be increased as high as 40% where a wing is operating at a distance of about a chord length to the ground. It also has been shown that while the lift is increased moderately at lower angles of attack, diminishing somewhat at the higher angles when operating near the ground boundary, the drag forces decrease considerably more in proportion at high angles of attack. As the wing is moved away from the ground boundary the drag force has a continued diminished effect in greater proportion than the increased lift effect which drops rapidly. These relationships will vary with various airfoils and the lift and drag curves of *Figure 1* should not be considered applicable to any particular airfoil.

The drag force acting on a wing is actually composed of two forces, one of which is the profile drag or skin-friction drag of the wing, and the other, which is most important, called the induced drag. Induced drag varies with angle of attack, the coefficient of induced drag being high at high angles of attack and low at low angles. The profile drag coefficient is less important and is about constant for angles of attack up to the stalling point. In *Figure 1*, the drag curve is a combination of induced and profile drag, where the profile drag coefficient can be picked off at the angle of zero lift coefficient as being about .01 and remaining constant for angles up to the stalling point. At the angle of zero lift the induced drag coefficient would be zero. Notice what happens to the drag curve in *Figure 1* due to ground effect. At the angle of zero lift the two drag curves merge at .01 leaving the same profile drag coefficient. At high angles of attack though, the induced drag is reduced. This is just what happens in flight. The induced drag of the wing for any angle of zero lift is reduced when the wing operates near the ground. This means then that for a certain angle of attack, less power is required to produce greater lift at whatever velocity the wing is flying.

The question might be asked, just what is induced drag and why does it diminish near the ground? Induced drag is considered to be the drag resulting from the wing tip vortices which are generated at the tips when a wing is developing lift. Due to negative pressure on top of the wing and positive pressure below, there

(Continued on Page 56)

Hydraulic System Changes–DC-3

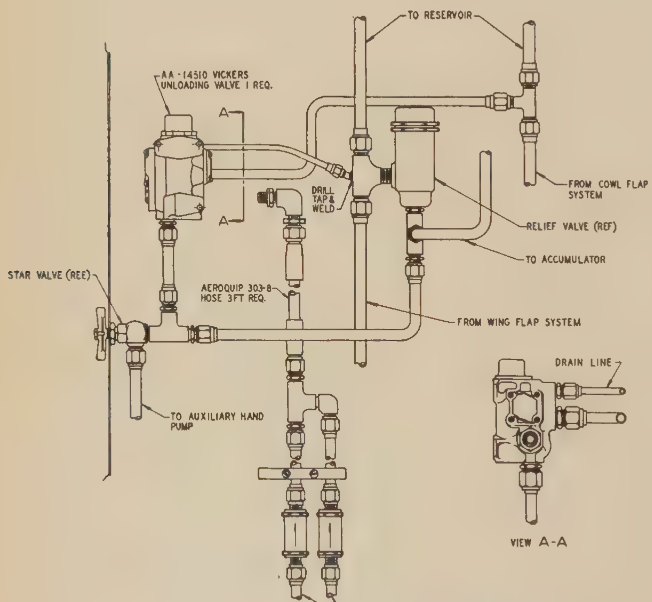
Modification of the hydraulic system of the standard DC-3 speeds landing gear retraction time, adds to flight safety

by W. L. Flinn
Vickers, Ltd.

STEP-DOOR *installed on DC-3 operates off plane's hydraulic system*

Several features of the Super DC-3 hydraulic system make it more efficient than the hydraulic system in the conventional DC-3, and some of these modifications already have been incorporated in DC-3's.

The first commercial SDC-3 aircraft are presently being operated by the United States Steel Corp. In these aircraft, the hydraulic system pressure was increased to 1100 psi. This was made necessary by the use of a smaller size landing gear retract cylinder. Also larger pumps were installed so that faster landing gear retraction time, together with improved over-all system operation, resulted. The pump selector was eliminated and both pumps were Tee'd to a common power line.



CIRCUIT *shows Tee'd pump system, hydraulic regulator on DC-3*

The most significant SDC-3 change which can also be incorporated in DC-3 aircraft is the Teeing of the hydraulic pumps. This also involves removal of the pump selector valve, and both pumps then feed a single power line. In favor of this change is the fact that DC-3 landing gear time is cut in half and take-off performance thus favored. A very real safety feature resulting from this change is the elimination of a routine and/or emergency cockpit operation. In the conventional DC-3, it is necessary to check the hydraulic control panel to be sure the pump on an operating engine is selected to deliver oil to the hydraulic system. When the Tee'd system is installed, failure of an engine in flight (and hence, loss of a pump) does not mean the temporary loss of the hydraulic system. Brake pressure is also assured on the ground when a single-engine run-up is made.

If a DC-3 is still equipped with the hydraulic auto-pilot, the pump selector valve is retained to select the left-hand pump to the auto-pilot or to the main hydraulic system (for double pump protection.) The right-hand pump is piped so as to supply oil to the main hydraulic system at all times. When this system is installed, both pumps feed the main system normally but especially at take-off. The one pump can then be selected for auto-pilot operation.

When pumps are Tee'd on a DC-3, it is necessary to replace the original Douglas pressure regulator with one of greater capacity. A Vickers AA-14500 valve is used on the U. S. Steel SDC-3 aircraft, and it is also used on many airline and business-aircraft DC-3 conversions. The first DC-3 conversion using the Vickers valve at MCA has accumulated 13,769 hours of trouble free service. Either Bendix or Air Associates valves can also be used.

The SDC-3 increase in hydraulic system pressure is not necessary or desired for conventional DC-3's.

The larger capacity pumps on the SDC-3's are not

OLIN INDUSTRIES DC-3 *was modified by Remmert-Werner by Teeing hydraulic pumps and installing larger Vickers pressure regulator*

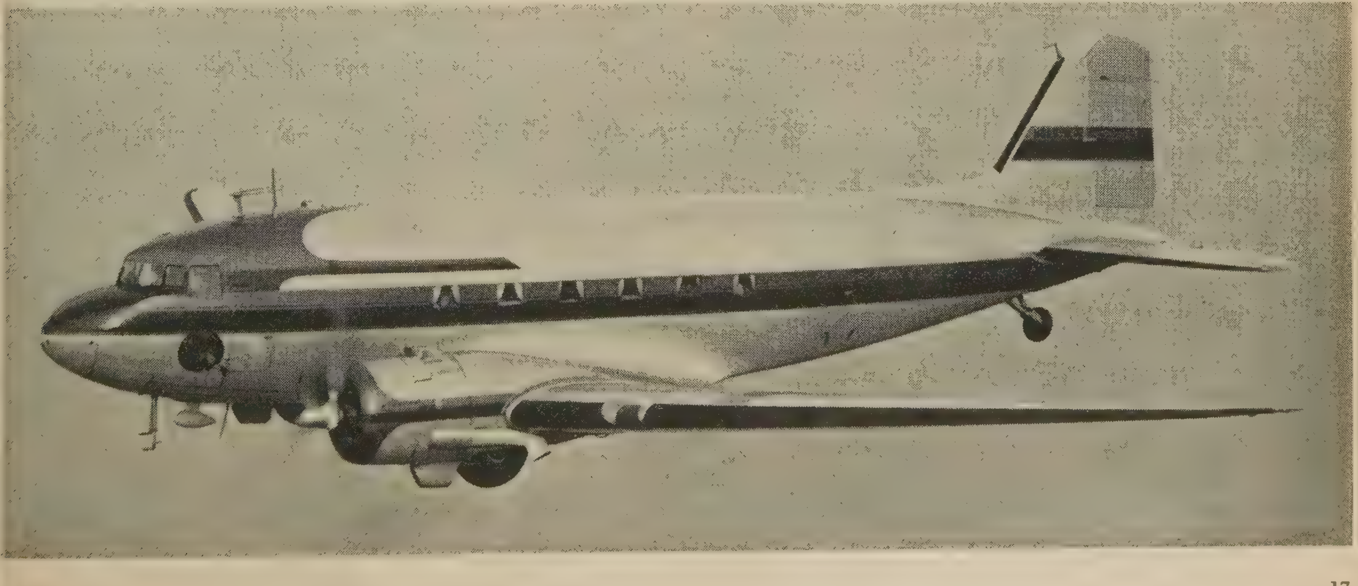
required for conventional DC-3's, but may be desired. The U. S. Steel SDC-3's are equipped with 3,000 psi Vickers pumps. Besides being interchangeable with equivalent units on most transport aircraft, they are also almost indestructible because of the low power requirements (900 psi.) of the DC-3. Many DC-3 operators have installed 3,000 psi piston pumps for this reason.

Only one DC-3 is known to have been equipped with the SDC-3 retractable tail wheel. Another is being modified by Remmert-Werner to include full-closing SDC-3 nacelle doors for the main wheels. Although some speed advantage may be gained from these modifications, they have not been generally considered for use by DC-3 operators.

Some DC-3 operators have installed a separate hydraulic system to operate the built-in-door passenger steps. In these cases the main hydraulic circuit is not disturbed and accordingly the weight of fuselage lines full of oil between the front of the airplane and the rear door is eliminated. In one case a B-24 bomb-bay door retract strut and an Adel electric-driven hydraulic pump (15668) was used. This is the same pump which was installed in the Globe *Swift* for landing gear and flap operation. The installation is so arranged that the door and steps can be opened or closed even if the power system is inoperative.

Tee'd pumps might well receive serious attention as a desired change for all of today's DC-3's primarily because of its safety advantage. The other changes must be evaluated by the individual and may or may not be of sufficient value to justify the charges.

THOMPSON PRODUCTS DC-3 *is another business plane that has been equipped with Tee'd hydraulic pumps for faster gear retraction*



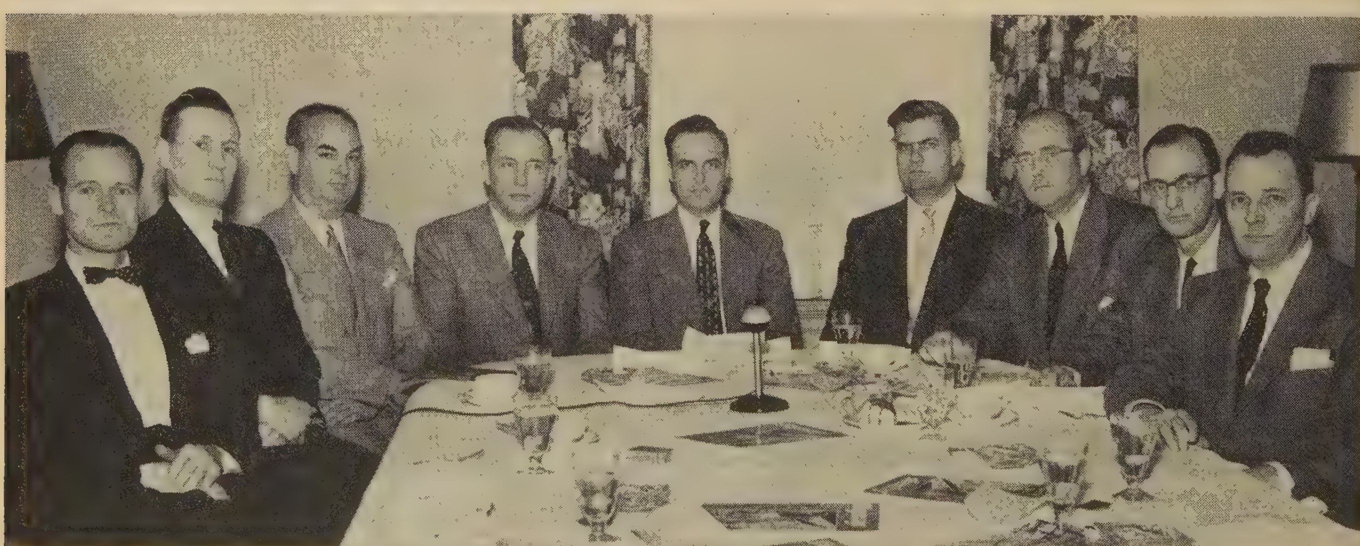
Problems in Aviation Equipment and Parts

Discussion indicates surplus continues on parts market; service operators call for manufacturers, distributors cooperation in not selling direct to end users

Moderator Francis L. Hine *(Pres., Airwork Corp.)*: "Gentlemen, we are here today to participate in SKYWAYS' 21st Round Table, this one devoted to problems of the aviation equipment and parts industry.

"To open the discussion on this broad subject, I'd like to read a portion of a treatise on the distribution of aircraft parts. Airwork's Florida Branch Manager, Mr. Jerome Church, deserves the credit for these comments. He wrote, 'Throughout the years of aviation development, the pattern of parts distribution has followed general economic lines. In many cases manufacturers expanded their line of products to include aviation requirements, and then used their already established means of distribution. In other cases, especially with regard to maintenance supplies, the products were used in general industry and so were distributed to the aviation consumer through established outlets, while the manufacturer of specifically aviation products sold his material directly to the customer. As the aviation industry expanded, some manufacturers were reluctant to take on the additional load of servicing the customer, so they offered distributorships for territorial coverage. Meanwhile, the aviation consumer also was demanding increased service, and the result was the development of a national aviation distributorship network. As it now stands, aviation products are being sold under every conceivable means of distribution, from direct factory sales to fully protected distributorships and dealer territories. However, aviation distributors are gaining strength and are rapidly increasing their ability to service the aircraft industry. Large stocks of current aviation materials are readily available at all major aviation centers, and authorized service stations and dealers are being established in every aviation locality. This system forms the basis of a healthy growth in commercial and private aviation.

"'The aviation distributor has a very definite responsibility to the in-



DISTRIBUTORS, *manufacturers attending Round Table on current problems in aviation equipment and parts industry included (left to right around table) Bob Durham of Durham Aircraft Service; Tom Moore of Pacific Airmotive Corp.; Frederick B. Woodworth, Smith-Meeker Engin. Co.; N. H. Mathey of Atlantic Aviation; Robert L. Mettey, Hamilton Standard; W. H. Lawrence of General Electric; F. L. Hine, Airwork Corp.; H. J. Andrieu, Eclipse-Pioneer; and L. Bollo, Standard Aircraft Equipment Co.*

dustry to justify his existence and his measure of profit. He must keep adequate supplies on hand to fill the current needs of his customers and also allow the manufacturer sufficient production time to replace the shelf stock. He should have full knowledge of the product and supply his customers with the latest technical information. The distributor also has a moral obligation to do everything possible to protect the customer against obsolescence and over-stock losses. The price tag on aviation has been reputedly high. The aircraft distributor can help reduce this price tag by giving a maximum amount of service. By concentrating on a relatively small number of complimentary products, he can operate his business in an efficient manner, thus relieving the manufacturer of distribution problems, and the airlines, the overhaul agencies and the fixed-base operators of their stocking problems. Most of all, dependability of supply of materials will go a long way in dependable aircraft transportation.'

"Gentlemen, that little treatise sets the stage for our discussion and I would like to ask you for your thoughts on this whole problem of supplying the aviation industry. Mr. Durham, would you lead off the discussion for us?"

Bob Durham *(Pres., Durham Aircraft Service, Inc.)*: "From my observation of today's situation, I would say we have too many so-called distributors who are actually jobbers or brokers. Since the Korean situation, the market has been sliced so thin that all legitimate distributors have felt the pinch and have found themselves with a limited volume of business in relation to the potential."

Frederick B. Woodworth *(Chief Engr., Smith-Meeker Engin. Co.)*: "As a corollary to that, a fundamental concern of the aviation industry from a distribution standpoint is tied up with the fact that most equipment requires the distributor to provide adequate servicing and repair facilities. I'm speaking now of the complicated field of radio. If the distributor does not provide this, he is not doing a good job. Setting up such facilities means a large capital investment. Therefore, despite their eagerness to get sales, the manufacturers should not appoint so many distributors that they weaken the whole picture for everyone. In other words, in a certain specified area, you cannot have more than a certain number of distributors. If you have too many, none of them are going to do a good job because the market is only so large."

F. L. Hine: *"How do you feel about some of the products that I like to call 'merchandising products', the ones that are not of a technical nature? Mr. Moore, you handle quite a line of non-technical items. How do you feel about it?"*

Tom Moore (*Service Sales Mgr., Pacific Airmotive Corp.*): "I am not in a position to discuss actual merchandising problems, but I would like to tie in with a service problem. My biggest problem is with the prime manufacturer. I want to know to what extent he will stand behind his product. Right now we are facing a severe problem having to do with tappet roller failures in the 1830's. When we overhaul an engine and put it out in the field, we have a warranty of 100 hours. We could have a warranty on our workmanship of a thousand hours, but we can't offer that because the prime distributor won't back us up on a material failure. If we overhaul an engine, all of which costs thousands in material and man-hours, and then we have an engine wrap-up on test due to a tappet-roller material failure that is worth two or three dollars, we have to stand the cost of complete re-overhaul. This has become quite a problem, for we stand in disfavor with our customer who does not realize that it was the manufacturer's part that failed, and not our engine overhaul. The prime manufacturer will stand the cost of the new roller, but we have to stand the financial brunt of the overhaul to replace that roller."

F. L. Hine: *"That is a question of coordination between the distributor and the manufacturer in servicing the customer. Let's see how a manufacturer feels about it."*

Harry J. Andrieu *(Service Sales Mgr., Eclipse-Pioneer)*: "As far as the failure of a service part is concerned, each individual company has its own warranty policy. To my knowledge, our customer—the distributor—has never reimbursed any overhaul activity for the number of hours they have spent in overhauling a piece of equipment. From time to time, there are certain specific policy decisions made regarding this, but it seems to depend on the type of equipment and the number of hours it has been in service. Other than that, the only thing I can say is that it's a policy that would have to be worked out on an individual basis for any overhaul activity."

Robert L. Mettey *(Coml. Field Service Supv., Hamilton Standard)*: "On the question of the manufacturer standing behind his product, I agree with Mr. Andrieu on that, ex-

Round Table Participants

FRANCIS L. HINE, who served as Moderator of discussion, has been president of Airwork Corp., since '46. He is Yale graduate, and served as Lt. Col., U. S. Army, during World War II.

W. H. LAWRENCE has been with General Electric as Aviation Sales Engineer since 1946. He is graduate of Univ. of California; served as Lieut., U. S. Navy, in the Pacific during the war.

F. B. WOODWORTH, Chief Engineer of Smith-Meeker Engineering, joined that company in 1938; worked on early development of omnirange and radio-telephone with Bell Laboratories, 1928-38.

H. J. ANDRIEU joined Eclipse-Pioneer in 1943 to assist in establishing systems, procedures in Parts Sales Dept.; became Parts Sales Supervisor, and is now serving as Service Sales Manager.

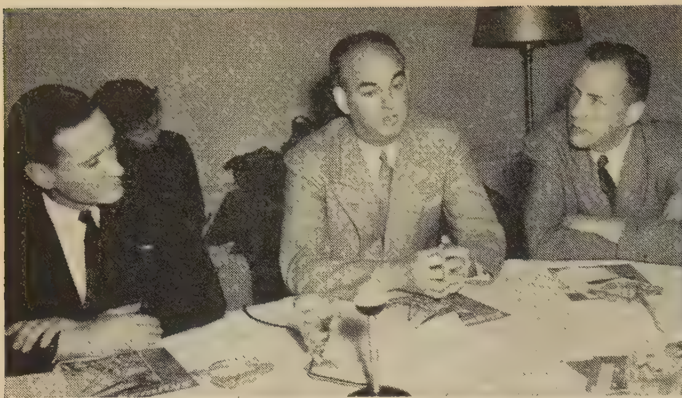
ROBERT M. DURHAM organized Durham Aircraft Service in 1944; company has two branch operations, one at International Airport, the other (engine and carburetor overhaul) in Mineola.

TOM D. MOORE joined PAC in 1947 after serving as a Naval officer during World War II. Prior to sales work, was Production Control Manager for PAC; today is Service Sales Manager.

R. L. METTEY, Supervisor of Field Service Engineering for Hamilton Standard, graduated from Boeing School of Aeronautics in 1941; joined Hamilton Standard immediately thereafter.

N. H. MATHEY began his aviation career in operations department of Eastern Air Lines; served as Station Mgr. at Memphis, Nashville, New Orleans, etc. He joined Atlantic Aviation in 1953.

LOUIS J. BOLLO, president of Standard Aircraft Equipment Co., organized the company in 1953. Prior to that, he was associated with Eclipse-Pioneer and managed Eastern Service Branch of E-P.



"TOO MANY *distributors of a product in a single area weakens the sales picture for everyone," stated F. Woodworth (center). Sitting to his left is Mr. Mathey; to his right, Mr. Moore*

"BUSINESS PILOT *needs one central source of information on availability of parts," reported Mr. Hine (right), sitting next to Mr. W. H. Lawrence (center) and Mr. R. L. Mettey (left)*

cept that some of these are special cases and as such are handled individually. Hamilton Standard employs a policy for replacing parts that are proven faulty within the warranty time. Usually, labor charges are not covered by this warranty."

F. L. Hine: *"In other words, the manufacturer stands behind his part on a warranty basis, but when the overhaul agency runs into the problem of a defective part, it is faced with the expensive job of overhauling the whole piece of equipment, whether it be an engine, a propeller, or anything else.*

"Mr. Mathey, what are your problems in dealing with the actual owner of the aircraft?"

N. H. Mathey *(Operations Mgr., Atlantic Aviation)*: "So far we have had very little difficulty."

F. L. Hine: *"Apparently then, the problem ends up with the middleman, the overhaul agency. Speaking for Airwork, it is rather expensive overhauling a complete new engine because of the failure of one small inexpensive part. The manufacturer will replace the part, but the overhaul agency has to bear the cost of re-overhauling the engine.*

"I'd like to change the subject a bit now and go on to another problem that I think is prime in the aviation industry. That is the question of building special inventories for customers. You have a customer and you stock heavily for him so that you can do a good job. But you wake up one morning and find the customer has gone over the hill to a competitor, and you are left sitting with an excessive inventory and nobody to sell parts to."

Louis J. Bollo *(Pres., Standard Aircraft Equipment Co., Inc)*: "I'd say that the man who wakes up with an inventory on his hands and no use for it has not been on the job. He hasn't been doing a job of selling. With Bendix products, we worked out an interchange in inventory from one distributor to another, and that has proven helpful to us. If you have something that is saleable but you can't sell it, offer it to 15 other distributors and you'll stand a chance of moving it off your shelf. That's about the only 'out' you have if you get yourself into a position of having too much inventory."

F. L. Hine: *"Let's take up that problem with Mr. Moore. Some of the other equipment—engines, for example—is a little more difficult than accessories. An airline or a large corporation user can switch planes on a minute's notice or an airline can move its operations from the West Coast to the East. Do you run into that problem, Mr. Moore?"*

Tom Moore: "Yes, we do. As a matter of fact we're running into that sort of thing right now. Many of our business-plane operators are doing away with their 1830-92's and are getting into the -94 field. They want more power and that is one of the ways they have of gaining it. We have an inventory of 1830-92's, and we also have an inventory of 1830-94's. Having forseen this change, we have maintained an adequate inventory to supply the customer with what he wants. At the present time we are attempting to build up our inventory of engines and engine parts for the -94 since the R1830-92's show definite signs of being on the way out."

L. J. Bollo: "When you recognized that fact, didn't you start to cut down on your inventory for the 1830-92's? You have branches in other parts of the country, and isn't it possible that the -92 might be more popular in other sections of the country? Could you ship them from one place to the other? I realize it would cost you money to do so, but at least you would be cutting down on any excessive inventory."

Tom Moore: "That's exactly the way we work. We have branches on the West Coast and they supply us with -94's and we supply them with -92's. We just keep moving them around. But if you are on your own and don't have a branch, you have to put a closer watch on the trends."

F. L. Hine: *"How does the military enter this picture? Whether the military is going to develop its own maintenance or make wider use of the commercial facilities would have a bearing on inventories. Mr. Lawrence, what do you say to that?"*

W. H. Lawrence *(Mgr., Aviation Sales, N. Y. Div., General Electric Co.)*: "That is not under the jurisdiction of the New York office, so I can't answer that question. In general, however, we do not market through distributorships. We like to keep as close to the ultimate customer as possible, including the military, and so his direct desires are known by the company. We, therefore, can gear our production lines to keep shipments short enough so that he doesn't get into too much trouble. Through the use of field engineers and field services, we try to anticipate the government's desires so that we can bring to their attention the desirable features of buying enough stock to prevent getting into trouble when they call us in emergencies. If we see that a particular part is wearing heavier than anticipated, we encourage the military to either buy more of that part or to alter its design to eliminate heavy wearing."

F. L. Hine: *"You mentioned that you handle your commercial customers direct. Do you find that a problem or is it a successful way of doing it."*

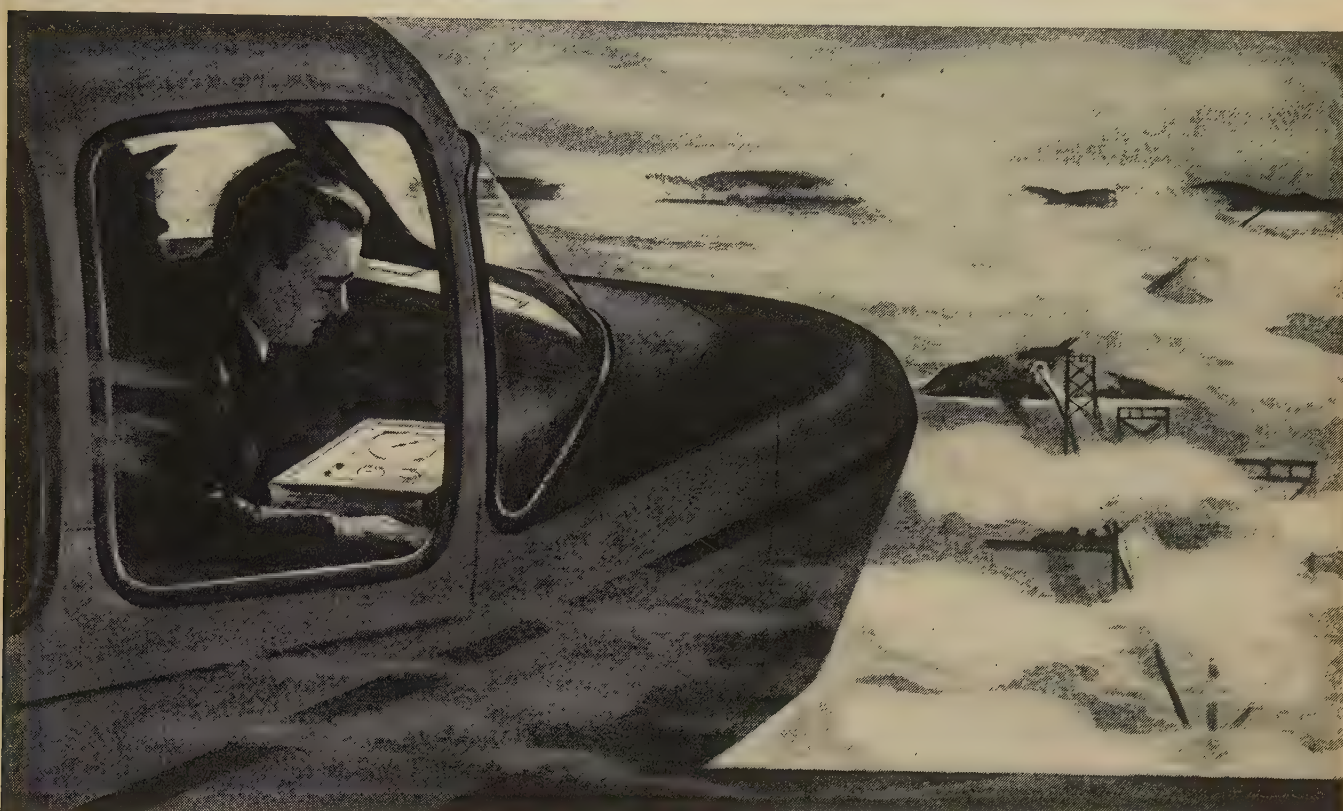
W. H. Lawrence: "So far it has been very successful. We get closer to the customer's problems than we

(Continued on Page 52)

PLANE FAX

Your Best Week-end Flight Plan for July

Fly to Long Beach, California, to watch the start of the Eighth Annual All-Women Transcontinental Air Race, July 3. You'll get quality Standard Aviation products and service at Long Beach Municipal Airport.



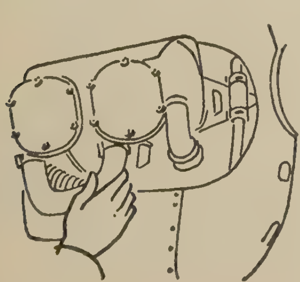
Sampling fog 500 feet over San Francisco Bay

Research takes to the air! University scientists rent a Navion from Jack Nystrom, manager of Palo Alto Airport, to flight-test "cloud-sampling" instruments above San Francisco Bay. The devices are used at 500-foot intervals, from 500 to 10,000 feet, to measure water content, impurities, and other properties of haze, fog and smog.

"Flying low over the Bay can be fun," says Ray Whitmore, Mr. Nystrom's chief pilot, "as long as I know my plane's in top condition. With RPM Aviation Oil in our engines, we have no trouble with valve sticking or rough running, and our engines never knock even during take-off or on fast climbs under heavy load."

"Whether we use our planes for smog sampling, forest patrols, or student training," says Mr. Nystrom, "we get ⅓ more flying time between overhauls with RPM Aviation Oil. It ends ring-sticking, reduces wear, and keeps our engines so clean that we save labor at overhaul. And because 'RPM' prevents pre-ignition and holds down cylinder head temperatures, we don't know what it is to have to replace pistons. They seem to stay in good condition indefinitely."

T.M'S "RPM," "CHEVRON," REG. U.S. PAT. OFF.



TIP OF THE MONTH

It's a good idea to check your engine's exhaust system for cracks or other leaks. They'll show a grayish lead deposit on the outside of the pipes.

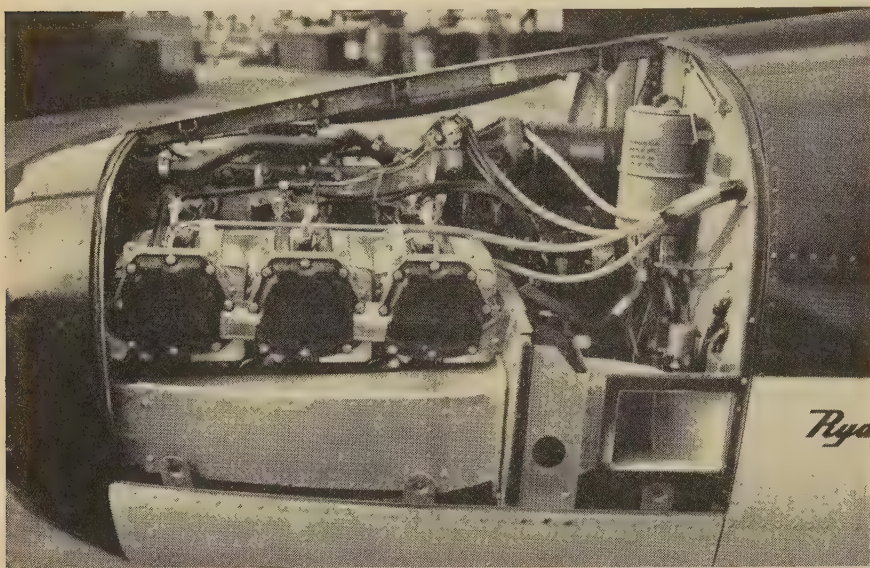
CHEVRON AVIATION GASOLINE

RPM AVIATION OIL

STANDARD OIL COMPANY OF CALIFORNIA

SKYWAYS FOR BUSINESS

NEWS NOTES FOR PILOTS, PLANE OWNERS OPERATING AIRCRAFT IN THE INTEREST OF BUSINESS



SPARTAN *modifications to improve engine cooling on Navion 260 retains "up-drafting" of airflow around cylinders. Heat from exhaust stacks is diverted; baffles, etc., redesigned*

Modifications Improve Cooling, Add Engine Life to Navion 260

New York, N. Y. Business firms and individuals owning and operating the Ryan *Navion* 260 will be interested and heartened to know that the CAA has flight tested and approved a combination of alterations to improve engine cooling. One such modification has been made by the Aviation Service Division of Spartan Aircraft Company, Tulsa, Oklahoma, and another one by NeoAir, Inc., Van Nuys, California. The modifications have been confined to the engine installation and cooling system of the Ryan production airplane.

The basic problem tackled by Spartan engineers was the elimination of overheating and detonation. Through exhaustive flight tests, engineering, modifications and retests which covered a period of several months, data was accumulated from which the original installation was refined to provide temperature levels far below their former readings.

Disregarding attempts by others, Spartan retained the original "up-drafting" of the airflow around the cylinders, rather than following the trend to downdraft the engine. Heat from the exhaust stacks has been diverted and baffles and sealing clearances redesigned to effect smooth flow and eliminate lost air. Where air to the oil radiator originally was secured from the engine compartment, Spartan has perfected an effective ram air duct. Improving the inlet airflow made it necessary to re-arrange various equipment in the engine compartment as well as modify the nose grill itself.

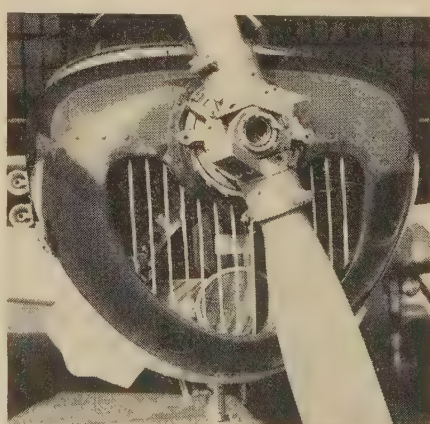
An experimental installation of top cowl flaps was tested and rejected by Spartan. This was an effort to obtain a reduced pressure on the top of the cylinders, to increase the pressure differential between the bottom and the top of the engine compartment.

The effect of each change was verified by Spartan engineers through measurements by thermocouple of the temperature at three points of each cylinder and the use of manometers to detect airflow differentials under various configurations.

A variety of grids and diffusers were installed in the fuel system and the effectiveness of fuel distribution measured. The octane of the fuel used was found to be of major importance.

The airplane on which the work was done is owned by the news and photographic departments of The Tulsa *Tribune.*

Navion owners interested in Spartan's conversion should write or phone F. J. Tolley, Aviation Service Division of Spartan Aircraft Company, Tulsa, Oklahoma.



NOSE GRILL *of the Navion 260 also was modified to improve the inlet airflow*

The NeoAir modification is a Torsion Cooling Unit which offers more efficient cylinder-head cooling, even engine temperature, cooler oil temperature, less noise in the *Navion* cabin, smoother engine performance, less drag and more mph, a cooler cabin and longer engine life. The cabin cooler is reported to be the first evaporative-type cabin cooler designed exclusively for the *Navion* and is guaranteed to reduce the cabin temperature by 15°. It is installed directly aft of the firewall.

The Torsion Cooling Unit for the Continental E Series engines requires a maximum of 25 man-hours for installation, and costs $440 F.O.B. Van Nuys. This includes a new nose cowl and the Ryan Type 1949 Cabin Cooler air inlet.

The evaporative-type Cabin Cooler unit is priced at $87.50, F.O.B. Van Nuys.

For further information concerning these NeoAir units, write NeoAir, Inc., 14644 Keswick St. Van Nuys, California.

IBM Corp. Sets Up Scheduled Air Service Between Plants

Endicott, N. Y. International Business Machines Corporation recently inaugerated regularly scheduled flights between its Poughkeepsie and Endicott plants. The service, planned to facilitate transportation of non-executive personnel and vital machine parts between its plants and other important points, makes IBM one of the few businesses operating a private airline on a regularly scheduled basis.

IBM's new twin-engine seven-place Aero *Commander*, piloted by Capt. Charles A. McKinnon, former UAL pilot, makes two round trip flights twice weekly between the plants, and operates on a similar schedule between Poughkeepsie and Boston. On weekends, the *Commander* flies on a non-scheduled basis between the company's plants and laboratories and Boston, Dayton, Washington, D. C., New York and other cities to accommodate personnel engaged in important projects.

A punched card system has been set up to make immediately available data relative to the airplane's operational costs on a per-hour, per-seat-mile, and per-passenger-mile basis. Should the volume of traffic warrant it, IBM will either lease or purchase additional aircraft.

News Notes of Aero Activities

Toledo, Ohio. On April 1, Remmert-Werner, Inc., of St. Louis, Mo., began operations at Toledo Municipal Airport. Remmert-Werner will provide complete 24-hour service on all types and sizes of privately owned aircraft at the existing

airport until completion of the new Toledo Express Airport, at which time R-W will move its facilities to the new field.

•

New York, N. Y. Flight Safety, Inc., Marine Air Terminal, LaGuardia Field, has prepared a CAA-Approved flight manual for the Douglas DC-3 which provides for increasing the gross take-off weight. The manual also contains practical sections dealing with cruise control, flight planning, loading, etc. Flight Safety arranges all the paper work with the CAA as well as having the airplane inspected and re-certificated.

•

Wichita, Kan. Aicraftco, Inc., has been appointed Beechcraft distributor for western and central Kansas. Located at Wichita's new Municipal Airport, Aircraftco offers 24-hour line service, complete maintenance and overhaul work and installation of all radio and electronic equipment.

•

North Hollywood, Calif. A new custom-type luxury passenger seat has been designed for the new Twin Beech Model 18 series by a Hardman Tool and Engineering Company, Los Angeles. Hardman is also developing pilot and copilot seats in addition to its regular *Siesta* luxury cabin seats for the new *Learstar*.

•

Yakima, Wash. Central Aircraft has released prices on the *Air-Tractor*, a new dusting and spray plane *(see Skyways, March)*. These are:

Model 101-A: Complete duster or sprayer (combination extra), majored engine and prop, ready to operate $14,975

Model 101-B: Same as A, but less engine, prop and mount $12,475

Model 101-C: Same as B, but less dust chutes or spray booms, etc, but with hopper and cockpit controls $11,780

All prices are flyaway factory, Yakima.

•

Santa Monica, Calif. The Santa Monica facility of Lear Aircraft Service Division has been designated a CAA-Certified Repair Station, Airframe Rating—Classes 1, 2, 3 and 4. This division of Lear, Inc., offers aircraft maintenance and repair service; design and installation of custom interiors, etc.

•

LEAR's *Cruse (left), J. Sparks accept certificate from CAA's Robinette (center)*

....in the Business Hangar

Tom Smith and Lyle Seelig, pilots for Shamrock Oil and Gas Company, had their company's Twin Beech and *Lodestar* at Southwest Airmotive for 100-hour check and radio repairs.

Air Products' Lockheed has been in the shop at Lockheed Aircraft Service, New York base, for gear removal and overhaul. John P. Meyers flew the plane in.

Jim Harrison, chief pilot for Bogue Electric Mfg. Co. and Ken Lawrence brought their DC-3 to Universal Aviation Services, Inc., Easton, Md., for a thorough exterior cleaning and polish job as well as some additional upholstery work in the cockpit.

Lario Oil & Gas Company, Wichita, has had their DC-3 at Remmert-Werner for installation of Super-92 engines, Sperry A-12 autopilot and H-5 horizon, dual Collins Omni with RMI, Collins 51V glide slope, Edison Fire Detectors, as well as new instrument, radio and electrical panels and new wiring. In addition, Remmert-Werner is modifying the DC-3's center section and rudder trim tab, overhauling the landing gear, and soundproofing and upholstering the cockpit. Boots Johnston and his copilot, Ken Riggs, soon will be flying the "new" DC-3.

Newark Building & Supply Co., Newark, Dela., recently bought an Aero *Commander* from Reading Aviation Service. The airplane presently is in the RAS shop for installation of a Lear L-2 and approach coupler, dual ARC Omni, Lear ADF 12 and LVTR 36 and marker receiver, and an ARC T-11B transmitter. The instrument panel is also being reworked for dual instrumentation and will incorporate a Sperry H-5, and a Sperry C-2 Gyrosyn system and landing speed indicator. Ray Burkland, president of Newark Building & Supply Co., will be the pilot of the plane.

Thatcher Glass, Elmira, N. Y., has equipped the company-owned *Lodestar* with a Flite-Tronics CA-20 cabin amplifier. Torch Lewis, pilot of the plane, had Potter Aircraft Service at Burbank, Calif., make the installation.

Chappie Lenox and Eddie Hart, pilots for British American Oil Producing Co., Dallas, spent a few days in Burbank, Calif., while Aircraft Tank Service, Inc., did a tank reseal job and made brazier head modifications on their company *Lodestar*.

Rick Ravitts brought the Camcar Screw Company's Twin Beech to Remmert-Werner recently for installation of a Wilcox CAT, a double engine change and a 100-hour inspection.

Western Realty Company's Cessna was at Southwest Airmotive for a prop check. D. A. Terry is Western's pilot and home base is Houston.

Shea Chemical's Aero *Commander* is back in the air after a 100-hour check by Universal Aviation Services. Jim Pashley is the company pilot.

Pete Carney, chief pilot for Rowan Oil Co. and also his company's NBAA representative, has Rowan's *Lodestar* flying again after a tank reseal by Aircraft Tank Service, and a 100-hour inspection by Pacific Airmotive Corp.

National Cash Register has added a Flite-Tronics CA-20 cabin amplifier to its DC-3. Qualitron, Inc., Burbank, made the installation. Pilot for the company-owned Douglas is Don Keeley.

Larry Durham, pilot for the Heath Co., Benton Harbor, Mich., brought his company's Aero *Commander* to Reading Aviation Service for major autopilot work and a 100-hour inspection. The Heath Co. very recently took delivery of their second *Commander*.

A Grimes rotating beacon recently was installed on the St. Louis *Post-Dispatch* DC-3 by Remmert-Werner. Pilot John Matthews also had the plane at R-W for a double engine change, center section modification and relicensing.

Official NBAA Report

NATIONAL BUSINESS AIRCRAFT ASSOCIATION, INC.

(formerly Corporation Aircraft Owners Association)

National Business Aircraft Association, Inc. is a non-profit organization designed to promote the avation interests of the member firms, to protect those interests from discriminating legislation by Federal, State or Municipal agencies, to enable business aircraft owners to be represented as a united front in all matters where organized action is necessary to bring about improvements in aircraft equipment and service, and to further the cause of safety and economy of operation. NBAA National Headquarters are located at 1701 K Street, N. W. Suite 204, Washington 6, D.C. Phone: National 8-0804.

NBAA Member Wins Public Relations Assn. Award

Congratulations to NBAA member, The Garrett Corporation, for receiving the Silver Anvil Trophy of the American Public Relations Association, Washington, D. C., for outstanding achievement in industrial relations in the 1952-53 period. Garrett is the first aircraft manufacturing concern to win this award.

NBAA Reviews Aviation Weather Services

One indispensable step taken by the business pilot before scheduling a cross-country flight is weather briefing. No experienced pilot, business or private, would consider taking off on a long trip without a knowledge of current weather conditions, the changes expected, and the "best-way-out" in case unexpected changes occur.

For many years the Weather Bureau has actively encouraged all pilots to inquire in person wherever possible, especially concerning the last two items, before taking off. Special briefing facilities and trained personnel are maintained by the Bureau at more than 230 airports for this purpose. Fifteen years ago there were almost as many briefing offices as today. However, in that period the number of cross-country flights requiring briefing has multiplied many fold. Also, technological advancements by the aviation industry have made flying more complex these days, so that briefing not only requires more skill but tends to consume more time.

The net result is that at busy terminals like LaGuardia, Chicago and Los Angeles, the demand for aviation weather information is so great that it is almost impossible to obtain a personal briefing on short notice by telephone. Moreover, at such places as Pittsburgh, Cincinnati, and Ft. Worth, where airlines operate from one airport and business and private pilots from another, the Weather Bureau has been unable to maintain briefing staffs at both. It seems unlikely that this problem can be solved realistically merely by having the Government add manpower. Some suitable means must be found to mass-disseminate the critical weather information the pilot needs for planning his flight.

The problem is not critical for the airlines, first, because there is usually a Weather Bureau office open 24 hours per day at most major airline terminals; and second, because the airline pilot has a dispatcher—in many cases a meteorologist—who has access to the teletype or facsimile machine from which flows a continuous stream of weather data and forecasts, which are furnished the pilot as necessary. It is the business and private pilot who is most difficult to serve adequately.

Consider, for example, the need for briefing service at, say, Lunkin Field, Cincinnati. More than 3600 flights originate from that airport per month. What kind of facility or presentation of weather information would best serve the pilot's purposes in planning a flight to Chicago? A few possibilities might include:

1. Teletype sequence and/or facsmile materials display. A self-briefing counter maintained by the airport operator.
2. Automatic telephone service. A canned briefing containing current terminal weather and forecasts and a summary of critical weather and winds expected along the routes radiating from Cincinnati within a radius of 300 miles.
3. Automatic continuous radio broadcasts on VHF bands.
4. Same as (3) except the L/MF range facility.
5. Remote personal briefing by television, including direct audio line and video map display.

The last means, while obviously the best, would be the most expensive. The others would require an educational campaign to enable the less-experienced pilots to utilize effectively the "canned" materials as a basis for flight planing. Perhaps the most important feature of any weather briefing is planning a best-way-out in case of forecast failure. Forecasts, at best, are scientific approximations and can be expected to fail 10-15% of the time. Unfortunately, most failures result from accelerations which often lead to sudden development of extreme or critical weather. Hence, the pilot should never leave the ground without knowing what alternative course he would fly in case he encounters weather troubles. How can the Weather Bureau best provide facilities for remote or "canned" briefing for inexperienced pilots that will make intelligent flight planning possible?

Weather services and safeguards for the pilot in the air: Once the pilot is airborne the active role of the Weather Bureau in safeguarding the flight has been the maintenance of aircraft separation, the provision of twice-hourly broadcasts of terminal weather, and flight assistance services (mostly at the request of the pilot).

The primary weakness in this plan for safeguarding the pilot against weather hazards is that when a forecast fails and is amended, it is left mainly to the initiative of the pilot to find out that the briefing he obtained before departing is no longer a valid basis for continuing his flight. It assumes, moreover, that he will be able to establish contact on some air-ground channel. If he bases his decision upon terminal-weather broadcast routinely over range facilities, he may also be misled. Such a broadcast merely reports the weather which now exists at his destination and does not reflect forecast amendments which may tell of fog or squall-line developments expected to close in his terminal just before he arrives or before the next broadcast, at which time it might be too late to divert to a suitable alternate. Moreover, the broadcast of weather over range facilities at present is sometimes missed altogether because other air-ground traffic interferes, or distracts the operator from the broadcast schedule.

There is a real need for some means of continuously broadcasting not only hourly and special terminal weather reports and pireps, but also forecast information, including critical weather developments, severe weather warnings, etc. Again, one of the important features which should be incorporated into such broadcasts is an indication of which-way-out a pilot should choose if he runs into weather troubles.

One experiment in such aviation broadcasts is the VHF transmission from New York and Chicago Weather Bureau offices. These involve costly installations, cannot be picked up reliably further than about 35 miles away, and cannot be received on conventional aircraft radio equipment. For this reason, they are primarily useful in flight planning rather than for enroute flight assistance. In the next few months, a pilot project will be initiated by the Weather Bureau on the Arcola LF range to test an automatic continuous broadcast of the kind just described. While the LF range seems to offer the best solution to the broadcast problem, there are several disadvantages. One of these is the fact that satisfactory reception of voice broadcasts frequently necessitates use of a filter to reject the range signal. Since the signal strength is reduced by the filter, the range at which the aid remains effective is reduced.

It has been suggested that the Weather Bureau broadcast special weather warn-

ings for the benefit of operators of single-engine aircraft. The idea is to establish an additional safeguard for pilots of limited experience by discouraging them from attempting to fly in marginal weather conditions. On the other hand, the Weather Bureau has been criticized for giving operational advice to pilots when briefing them on the weather, the point of the criticism being that the pilot should make all operational decisions. The Weather Bureau recognizes that weather suitability varies widely among pilots, depending on their training, experience, and equipment. What is good weather for some may be bad for others—the possible combinations of weather-pilot-equipment factors contributing to weather suitability are very numerous.

The question facing us is: should the Weather Bureau assume the responsibility of issuing special warnings to pilots, or should all operational interpretations and decisions on weather suitability be left strictly up to the pilot?

The problem then is: how much information on forecast amendments and on critical weather developments should be furnished the pilot in the air and on the ground at the initiative of the Government? And, what is the best means of delivering this information?

Ways and Means of Meeting Requirements for Additional Weather Observing Facilities: Weather observations are presently made at more than 900 points in the United States and its territories. Considerably more than half of these are solely for the purpose of controlling landing and take-off operations of scheduled air carriers as prescribed by the Civil Aeronautics Board. Every time a carrier is issued a certificate to operate from an airport, some provision must be made for weather observations if they are not already available. While the law clearly places upon the Weather Bureau the responsibility for establishing suitable facilities, it does not specify how this shall be done or who shall man the stations. It would be most difficult for the Government to man all of these facilities. If it did, the Weather Bureau budget would exceed 50 millions, or double its present cost of operation.

To meet these requirements, it has been necessary to establish cooperative weather stations. In most instances, the air carrier has been the cooperator. Until recent years, this has been a very satisfactory solution to the problem. There are two reasons, however, why this is becoming a less than adequate solution. The observations by airlines' personnel are designed to serve the requirements of one particular company's operation from a given airport. When a second carrier is certified to operate from the same airport, the company making the observation is placed in the compromising position of furnishing critical weather data which will control the operation of its competitor. Moreover, the cooperator makes observations only during the particular hours of the day or night in which his aircraft are enroute to or from the airport. This not only complicates the problem of providing observations that meet the needs of other carriers but limits the usefulness of observations for business and private aircraft operating from the field, many of which have as urgent a need for good observations around the clock for landing purposes during critical weather as do the airlines.

The latter limitation is becoming an important factor now that business aircraft operations not only exceed those of the airlines but occur from a larger number of airports. The time is rapidly approaching when some means must be found to replace the present airline cooperative observation station known as the SAWRS.

One plan proposed was that the airport operator, or state or local airport authority, employ observers and assume the role as cooperator, retrieving the overhead cost through a system of landing fees. The Weather Bureau states that this type arrangement has worked very well at a number of places, for example—Teterboro, N. J.; Allegheny County Airport at Pittsburgh; North Philadelphia Airport; Meig's Field, Chicago; Davenport, Iowa; Gillespi Field, San Diego; and Glendale, California. Others are White Plains, New York; Islip, L. I., N. Y.; St. Petersburg, Florida; Bartlesville, Oklahoma; Van Nuys, California; Bellview Airport, Seattle; etc.

Another method proposed, and possibly a more effective means in the long run, is the use of automatic observing facilities of the kind now being developed by the Weather Bureau. The initial cost would probably be from 10 to 12 thousand dollars. Such equipment some day will undoubtedly come to be regarded as an essential and integral part of the basic airport equipment along with the runway lights and other landing facilities.

The automatic weather station will not likely be perfected and become available in quantity for several years. The immediate problem is how can the requirements for new facilities, and the replacement of existing SAWRS observations be most effectively handled in the next few years.

This important question and many others are to be answered at a Weather Bureau-sponsored panel discussion to be held in Washington in the near future. As a panel member, NBAA will report on the results of this meeting in a subsequent issue of SKYWAYS.

Radio Transmitter Interference In New York Area

NBAA recently discussed with the CAA Administrator the problem of interference to aircraft-control tower radio-telephone communications in the New York area. The following letter from CAA was received recently in connection with this subject:

"We understand that there is some pilot opinion that the radio transmitters of scheduled air-carrier aircraft are so high powered that they block out the transmissions of privately owned aircraft with comparatively low-powered radio equipment. Actually, the effect of difference in transmitter power is minimized by the radio receivers in control towers which have automatic volume control and signal limiting functions which are designed to build up some signals and reduce others so that they are heard with approximately equal volume even though they vary widely in strength when received.

"The observance of good operating practices is more important than differences in the power of VHF transmitters in the reduction of interference which is experienced in a given area. In many cases, the aircraft and the control tower use the same radio frequency as in the New York area where the frequency 118.7 mc is used for single-channel simplex communications between aircraft and the LaGuardia tower. Under these conditions, the frequency has the aspect of a party telephone line where a third party may break up a conversation and render it unintelligible.

"In addition to interference on the same frequency, the control towers suffer from interference between communications which are being received on different frequencies. The LaGuardia tower transmits and receives on VHF frequencies 118.7 mc, 119.9 mc, 120.3 mc, 121.5 mc, 121.9 mc, 122.5 mc and also maintains a continuous receiving watch on the VHF frequency 122.5 mc and on the HF frequencies 3105 kc and 3023.5 kc. It is frequently necessary to request repetition from an aircraft for the reason that his transmission was partly unintelligible as a result of interference from another aircraft transmitting on an entirely different frequency.

"It might be possible to consider measures for reduction of interference being experienced by NBAA aircraft in the New York area if we had specific examples of interference incidents. We should appreciate information, to the extent that it may be available, concerning actual instances which include the date, time, transmitting frequency in use, power of aircraft transmitter, and identification of the source and frequency of the interfering signal."

NBAA members as well as non-members who have encountered this difficulty would greatly assist in resolving this matter by sending their comments to National Hq.

NBAA Box Score

In appreciation of the efforts of many NBAA members in interesting non-member business-aircraft operators in joining the Association, future issues of SKYWAYS will contain a "New Membership Box Score." Full credit and commendation will be given to NBAA members directly responsible for bringing in new members, and a special award may be presented at the Annual Meeting to the member with the highest score.

New NBAA Members

Taylor Oil & Gas Company, Taylor Texas NBAA Representative—Tom R. Neyland, Chief Pilot. Company operates two Beechcraft D-18-S, Cessna 195.

Great Lakes Steel Corp., Ecorse, Detroit, Mich. NBAA Representative—Carl W. Gaenzler, Chief Pilot. Company operates a Lockheed *Lodestar*.

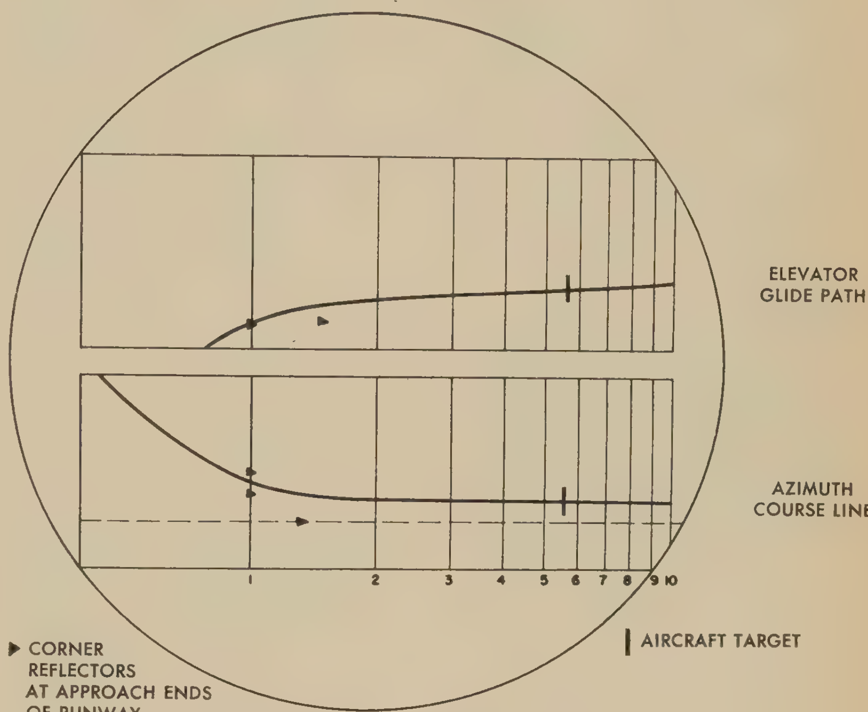
United Air Lines, Inc., Chicago, Illinois. NBAA Representative—W. A. Patterson, Pres.

American Mercury Insurance Company, Wash., D. C. NBAA Representative—A. H. Johnson, Exec. V.P. Company operates three Cessna 140's and a Piper PA-12.

Dallas Airmotive, Inc., Dallas, Texas. NBAA Representative—Henry I. McGee, President.

SPAR Demonstration Proves Accuracy of Inexpensive GCA

If you only wish hard enough for something, sometimes your wish may be granted. Evidently the aviation industry has been, like Mammy Yokum, conjuring up a whole "passel" of wishes. We wished for a navigation system that was atmospherics-free and accurate in course guidance—and the engineers came up with Omni. Then we wished for a way of instantly fixing our position on these accurate tracks—and they came up with DME. We wished for a visual means of following an aircraft through overcast skies and guiding it down to a safe landing—and they gave us GCA. But engineers were never cost accountants and so when we complained that all these things cost just too darn much money, most of the engineers just shrugged and went back to their Ouija boards—most, that is, except a small group in the heart of Boston, Mass.



PORTABLE GCA INDICATOR DISPLAY

Created in 1946 around a nucleus of wartime civil and military electronic experts, a company was formed and named Laboratory For Electronics, Inc. From that small beginning, the company has grown to a large organization specializing in the research, development and production of precision electronic equipment. LFE has prime contracted to government and industry on almost all phases of electronics.

With its high quotient of creative talent, LFE could have concentrated on developing a better radar than anybody else. Then, having achieved that, the company could have ignored the fact that, as radars go, today's equipment is very happily successful—except that the taxpayer cannot afford enough of it to make an appreciable dent in the airways congestion picture.

Fortunately, LFE undertook and seems to have succeeded in producing a "bargain basement" GCA that costs a fraction of the price of existing equipment, with about one-tenth the weight and possessing a mobility known only to the military trailer units which are not suitable for civilian applications.

At a demonstration conducted at Boston's Logan Airport, LFE undertook to show an industry group of aviation writers just what could be done for so much less cost. Flown up from New York in a chartered Northeast Airlines *Convair,* the party arrived over Boston to find a wind and traffic situation that was calculated to do its best to foul up the demonstration.

The equipment was set up for approaches from the southeast, landing northwest on Runway 33, and the wind was blowing 20 to 30 mph out of the east southeast, a nice brisk quartering downwind and *Convairs* do not waste any time on slow approach speeds! Capt. George Steers was in the left seat and an RCA industrial TV monitor camera was peering over his shoulder, picking up the view forward through the windshield and displaying it on a table-model TV set in the front of the shaded cabin.

Throughout the approaches at Logan, traffic kept pouring up off the runway in the face of the *Convair* and later the LFE Twin-Beech that flew the runs for the party to observe from the ground equipment site.

True to nature, there was a completely unrelated radio communications difficulty outside of a seven-to eight-mile range of the equipment site, so that in order to maintain radio contact with the controller, LFE Project Engineer Nicholas Repella, it was necessary to make all procedure turns-onto-final within a seven-mile radius of the site.

Obviously, it would have been understandable if the runs had been bad, but such was not the case. SPAR (for Super-Precision Approach Radar) and Nick Repella split the runway centerline not once, but virtually every time traffic and the tower allowed the aircraft to get past the two-mile mark!

Not too impressed because I have seen CAA and military controllers equal the performance many times under almost as difficult circumstance, we landed for lunch and to have a look at the equipment.

Had I been a person unfamiliar with radar antennas in general, I might have walked right by the equipment. It was literally a shock to find an exposed pair of antennas, hardly larger than a New York harbor boat's radar, rocking away like the treadle on an old-fashioned sewing machine. Sitting on what looked like an over-sized camera tripod, the whole rig could have fitted into the tonneau of one of the popular foreign sports cars!

A few feet away and connected

by cables stood the controller's console cab, about the size of today's average home milk delivery truck.

While we were standing there, leaning into a wholly uncooperative Boston Bay southeaster, a loudspeaker kept blaring the air-to-ground and ground-to-air conversation of the controller and the pilot of the company Twin-Beech. Meanwhile, the door to the supposedly darkened cab kept opening and shutting as a stream of aviation people wandered in and out. If I had been Nick Perella, I would have locked the door, for I have seen approaches jeopardized and almost lost by careless breaching of the dark security so necessary for safe GCA operation.

Finally I got inside, to see in the semi-dark a large cathode ray tube GCA display indicator about the size of a home 20-inch TV set. On it, both the Azimuth (representation from above of the ground surface on both sides of the extended runway centerline) and the Elevation (representation of the profile of the approach path from the ground up) were displayed in one continuous picture over a range of 10 miles. *(see cut page 27)*

Where normally the mileage range is evenly spaced, first over a 10-mile display and then over a three-mile display, with the increased accuracy as the plane progresses towards the runway dependent on the increased expansion of the picture from 10 to three miles, the LFE SPAR presents the whole progression logarithmically expanding. Thus, the accuracy increases as the target progresses without any necessity to change from one scope to another.

Startling also to anyone familiar with Precision Radar displays was the fact that the course line and glide path were also a logarithmic curved display and I fully believe the statement of Mr. Mal Jennings, Assistant Director of Engineering, that every first reaction of experienced personnel is one of horror at the idea of controlling a target along a curve so as to guide the aircraft straight into the runway centerline and down a flat tangent to touchdown. You have to see it to believe it, and do it several times to convince yourself that it works well.

I asked Mr. Jennings what experience they had with the equipment in seeing targets through heavy precipitation such as snow and rain. He replied that they employ X-band frequency with circular polarization as compared to the customary linear polarization and they obtain a 12-18 db improvement in target return through snow and rain. The question is important because current civil radar falls down in performance when needed most, when pilots are flying through heavy rain or snow and their own navigational accuracy is most hampered.

I also asked him what was the limit of antenna stability (and hence accuracy of presentation) under high wind conditions. He replied that tests support their guarantee of accuracy up to 60 knots of wind plus an inch of ice accumulation, and up to 100 knots of wind without ice accumulation. They do not shelter the antenna array as seen in current PAR practice and instead have built the antenna to withstand the elements and retain the ease of handling, moving and maintenance.

The obvious lack of the 360° area coverage present in Airport Surveillance Radars usually associated with Precision Radar installations raised the question of feeding stacked aircraft into the final approach path. His answer was that, with their 30° coverage out to 10 miles, they had encompassed a typical holding pattern on the final

Air-Aids Spotlight

ASHEVILLE, N. C.: *If current site tests successful, VOR replacing the VAR should be in operation by now. See Air Guide for frequency.*

BIRMINGHAM, ALA.: *Radar approach control procedures in effect.*

BOSTON, Mass.: *Radar approach control procedures in effect.*

CLEVELAND, O.: *Revised preferential routings in effect. Consult Air Route Center before filing IFR.*

COLORADO SPRINGS, Col.: *LF range and approach decommissioned. Voice communications switched to Outer Compass Locator on 239 kc, interrupting identification.*

DALLAS, Tex.: *ILS out until August; AS Radar commissioned.*

DAYTON, O.: *LF range and associated 75-mc markers decommissioned, approach cancelled.*

EVANSVILLE, Ind.: *Tower and INSAC saved by combining.*

JACKSONVILLE, Fla.: *Radar approach control procedures in effect.*

MEMPHIS, Tenn.: *Radar approach control procedures in effect on 119.1 mc.*

MEXICO CITY, Mex.: *Add to last month's Mexico data: tower operates on 118.3, also guards 122.5 LF range on 359 kc and MH beacon on 406 kc unchanged.*

MIAMI, Fla.: *Both LF and VOR range procedure turns revised to avoid conflict with Tamiami Airport traffic pattern. Missed approach pull-out also revised.*

MONTREAL, Que.: *Former amber approach lights replaced by new Hi-Intensity Approach, Runway lights on Runway 10.*

NEW YORK, N. Y.: *ADF oscillations on Maspeth Outer Compass Locator in westerly quadrant reminiscent of days when the frequency was only 3 kc separated from Allentown LF range. Automatic voice ident. in operation. Military forced return of 118.1 to LGA; check identification and interference with IDL approach control.*

PITTSBURGH, Pa.: *Combined Air Route Center and station may not save this area from being broken up and parceled out to adjacent Center (to save taxpayer's money).*

PORT LA PRAIRIE, Manitoba, Can.: *LF range now 314 kc, old tower frequency (now on 396 kc).*

SMITHVILLE, Tenn.: *Communications station moved to Crossville. No voice on either range at first, but other communications frequencies still available.*

ST. CATHERINE, QUE.: *This airport is Port of Entry for tourists only.*

WILLIAMSPORT, PA.: *Commissioning of a combined approach control tower and station may be sought to not only expedite traffic at this location but to permit extension of the low-altitude control Elmira-Binghamton system with the Allentown-Reading-Philadelphia-Harrisburg system, easing the New York Center workload.*

WINSTON-SALEM, N. C.: *CAA denies rumor that Lucky Strike is sponsoring the monitoring of the ILS LOM and LMM between hours of 2300 and 0700 —at the Winston-Salem Reynolds Airport.*

approach course and, in military test demonstrations, fed the aircraft out of the far end of the holding stack pattern onto the final, achieving both spacing and an ample final approach.

Mr. Donald F. Cutler, Jr., Executive Vice-President and Treasurer, stated that their experience so far indicated that major overhaul periods on the antenna pedestal array and electronic components was in the neighborhood of 1400 to 1500 hours. They have had six hours of outage for necessary maintenance in 1500 hours and they recommend a mechanical tear-down check every 5,000 hours, tube check every 250 hours as well as the customary daily voltage and alignment checks.

Availability of the installation was quoted as three to four months maximum for delivery. It seems to me that not only is the LFE SPAR a welcome newcomer to the field for the smaller terminals where density of traffic does not justify the current more expensive equipment, but that it offers radar coverage on the back course of ILS approaches, of which 30 are today published as "unusable"!

Today, the maximum use of Civil Precision Approach Radar is made in monitoring front course ILS approaches. Unfortunately, PAR installations, primarily because of cost considerations, are comparatively few throughout the country. Only the major hub terminals have them, approximately 10 in all. Eleven more have the less accurate ASR (Airport Surveillance Radar). If, in addition to the obvious need at smaller, medium-density terminals where both the ILS and GCA are unavailable, we can add PAR to existing ILS, ADF, VOR or even LF range approaches, the effect would be tremendous.

The application of the new "Look See" revision to Part 40 of Civil Air Regulations (*Navicom, May*) has had a significant effect already on the percentage of weather operations completed. Being able to descend to approach minimums, when weather is being reported below those minimums, has taken most of the sting out of weather reporting techniques that are admittedly far short of realism. GCA with the other approach facilities has accomplished this.

Although the obvious effects of the new Part 40 application where GCA and ILS are both available and used is of primary interest to the air-carrier pilots, its influence on the obtaining of general waiver of non-air carrier minimums to but not below air-carrier minimums for qualifying corporation crews should highlight the value of a GCA system as economical as SPAR seems to be.

New Air-To-Ground VHF Portable For Industry Use

A new low cost two-way VHF portable communications unit — the Skycrafters VHF "Multiphone" — has been developed and put into production by Skycrafters Aviation Radio at Long Beach, California, for use on frequencies between 110 mc. and 162 mc.

This versatile unit can be used on dry batteries, 6-12 volts D.C., or 115 volts A.C., by inserting the corresponding power package. In this way the "Multiphone" can be hand-carried for use in the field; used as a mobile unit in a car, airplane or helicopter, or used as a fixed station when plugged into a 115-volt A.C. outlet. A built-in loudspeaker is provided in the A.C. power pack for ground listening convenience.

The "Multiphone" is small and compact—measuring 8-1/2 inches high, and 5-3/8 inches wide, and 7-3/8 inches deep, and weighs only 12 pounds complete with batteries. It features rugged construction, assuring continuous operation under the service conditions usually encountered in the field.

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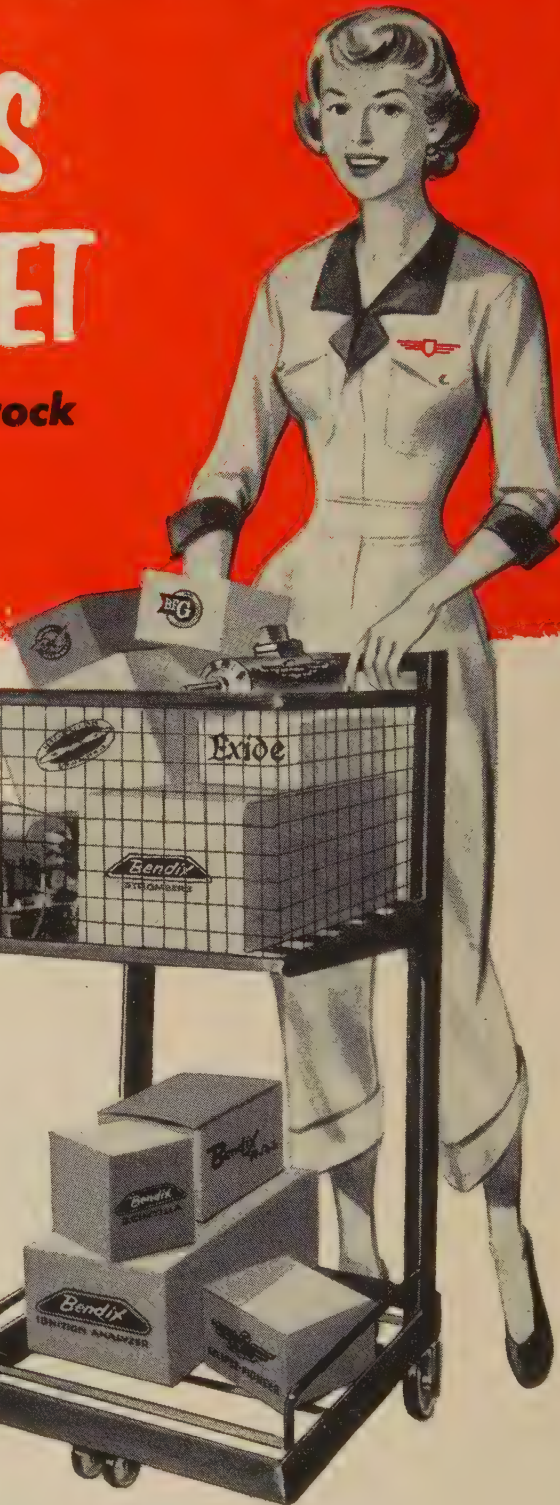

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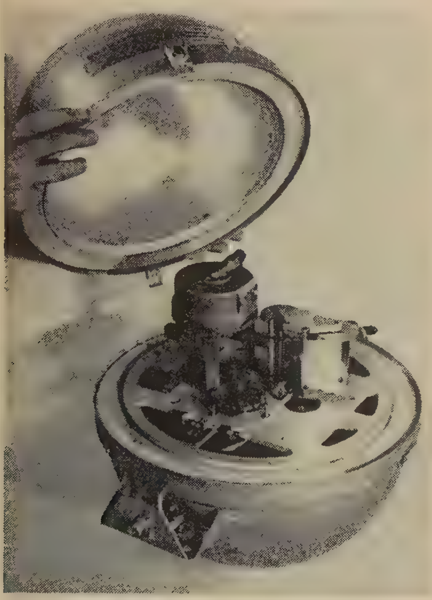
AIRCRAFT EQUIPMENT and ACCESSORIES

Analyzers & Flight Recorders

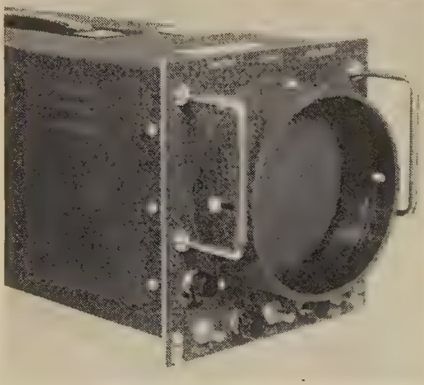


GENERAL MILLS, INC.
Minneapolis, Minn.

Flight Recorder Model A measures and makes continuous 300-hour record of airspeed, altitude, vertical acceleration, and time. Use of Flight Recorder enables business-plane operator to: 1. reduce inspection time through knowledge of degree of gust, landing shock, and over-stressing loads; 2. determine optimum flying conditions for maximum operating efficiency; 3. observe and improve take-off, flying, navigation and landing techniques for optimum flight and operating conditions; 4. have permanent record of flying and engine time; 5. determine fatigue conditions through a knowledge of frequency and intensity of stress conditions. Flight Recorder contains no electronic circuitry, no remote pickups. Unit weighs 16 lbs. with fireproof case. Indicates airspeed 0 to 500 mph; altitude —1,000 to +40,000 ft.; vertical acceleration —3G to +12G's. Direction Recording Element of Flight Recorder is an optional feature designed to work with fluxgate/gyrosyn equipment already available in user's aircraft. Power source: 22 to 32 volts DC. Dimensions: 13-1/2 x 16 x 15 inches high (fireproof case). Unit recommended for installation in tail of aircraft.

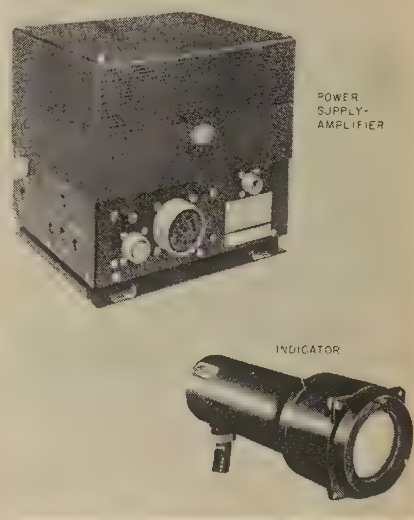
LAND-AIR, INC.
Chicago, Ill.

Engine Analyzer monitors an engine's operation and transmits visual pattern to the operator, enabling him to diagnose engine troubles; provides rapid and accurate inspection of engine ignition and mechanical malfunctions during flight. Unit weighs 22 lbs.; measures 13-11/16th x 6-5/8th x 11-11/16th. Can be used with high or low tension ignition systems. Available as permanent or portable installation.



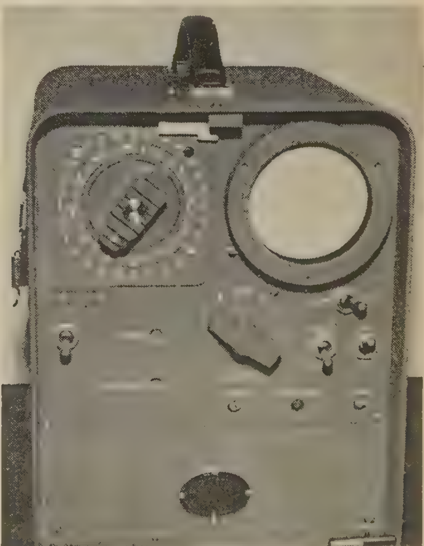
SCINTILLA DIVISION
Sidney, N. Y.

Ignition Analyzer is modified form of cathode-ray oscilloscope. When connected to switch wire of ignition system, it portrays on 5-inch screen voltage waveform produced by firing of spark plugs during engine operation. Companion installation is either No. 10-75305 selector switch panel for four-engine aircraft, or No. 10-75310 panel for twin-engine aircraft. Analyzer is 19 x 7-1/2 x 8 inches high; weighs 21 lbs.



SPERRY GYROSCOPE CO.
Great Neck, L. I., N. Y.

Engine Analyzer shows selected details of engine operation at precise instant each event occurs. Patterns are presented in trace of light on cathode-ray tube. Gives complete ignition and vibration analysis. Model D-2 (weighs 35 lbs.) and Model D-3 (weighs 65 lbs.) are available for two-engine aircraft. Model D-2 gives partial survey (ignition for all cylinders, vibration for one cylinder per engine); Model D-3 gives complete survey (ignition and vibration for all cylinders). Models D-4 (45 lbs.) and D-5 (93 lbs.) are available for four-engine aircraft.



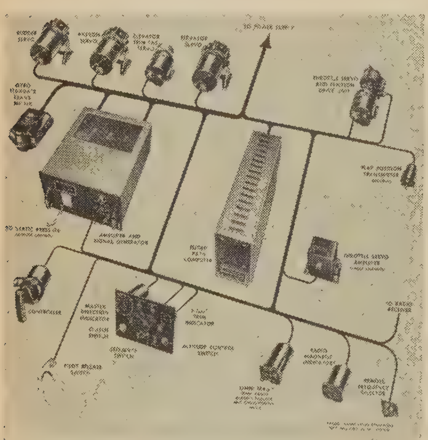
Portable Engine Analyzer is compact, self-contained unit for use on test stand,

in overhaul shop, on flight line, and on board aircraft for flight checking where there is no permanent Engine Analyzer installation. On aircraft not wired for engine analysis, the Portable Analyzer can be quickly connected by use of connectors which tee into ignition system at the engine firewall. Power requirements: .6 Amps 115 volts, 50-450 cycles, single-phase AC. Operates from sea level to 30,000 ft; will handle 9, 14, 18 and 28 cylinder engines. Unit weighs 33 lbs.

Autopilot & Assist Systems

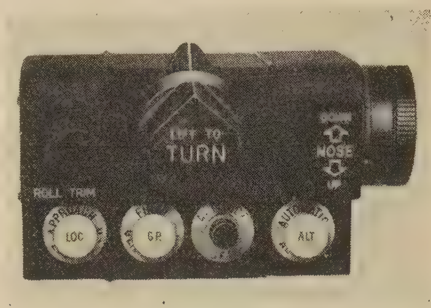
COLLINS RADIO COMPANY
Cedar Rapids, Iowa

AP 101 Automatic Pilot uses Collins Integrated Flight System as an integral part. Has no vacuum tubes and offers improved reliability and extreme flexibility for all types of aircraft. Installed weight of the new AP 101 is approximately 100 lbs.



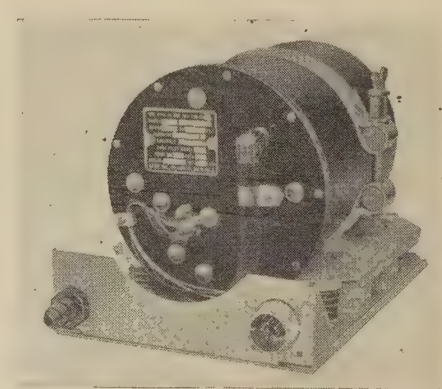
ECLIPSE-PIONEER DIVISION
Teterboro, N. J.

PB-10 Autopilot with FPC (Flight Path Control) offers automatic control to an omnirange course or to landing beam. On glide path descent, throttles are controlled in coordination with pitch attitude while yaw control maintains aircraft on localizer. FPC combines rate with radio displacement; instability that is common with manual control is minimized. On omni navigation, autopilot magnetic heading control is trimmed as necessary by radio control to oppose drift from course. Radio signal is smoothed out to prevent airplane from chasing over-active needle. Autopilot consists of Fluxgate system for magnetic indication and control; Servos tied into main control system; a Controller which permits adjustment of pitch attitude and change of heading while under automatic control; an Amplifier and signal generator; a 3-axis trim indicator permitting a visual check on out-of-trim conditions when aircraft is on autopilot; and a dynamic vertical sensor to give coordinated turns on autopilot yaw corrections.

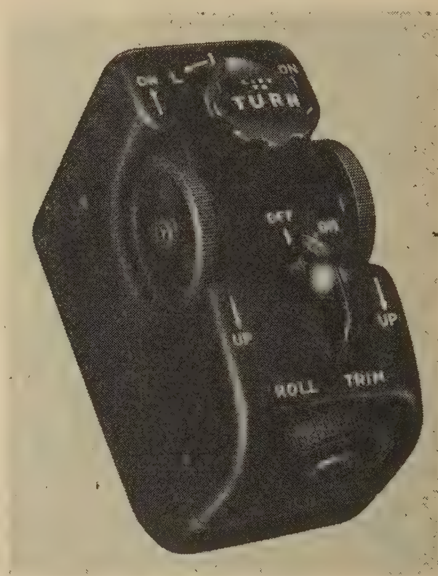


LEAR, INC.
11916 West Pico Blvd.
Los Angeles, Calif.

L-2 Autopilot is designed to perform, automatically and with precision, any normal maneuver in turbulent or still air. It is a stabilizing and maneuvering automatic pilot operating on all three axes—roll (aileron), pitch (elevator), and yaw (rudder). Turn on Engage switch and aircraft is under complete stabilized control on all three axes. To make a turn, rotate Turn knob in desired direction; stop the turn by moving knob back to neutral position. To climb, roll Pitch knob backward; to descend, roll it forward. L-2 is easily disengaged by a flip of switch on control wheel. Automatic trim tab control keeps plane in trim on pitch axis, assuring normal, no-load condition on elevators whenever L-2 is suddenly disengaged to permit manual flight control. Components consist of: Engage Switch, Controller (*shown*), Directional Gyro, Attitude Gyro, Triple-Axis Servo, Trim Tab Servo, Follow-Ups, Dynamotor, and Amplifier. Total weight, less electric cable, is approximately 36.7 lbs. Power requirements: 12 volt with three-axis servo (3.4 amps. DC standby; 10.2 amps. DC engage; 13.8 amps. DC maximum hard over signal on one axis); 24 volt with single and dual axes servo (2.0 amps. DC standby; 6.8 amps. DC engage; 8.5 Amps DC maximum hard over signal on one axis). Manuevering control limits: 10° in pitch; 22° in roll. Accessories include Approach Coupler and Altitude Control *(below)*.



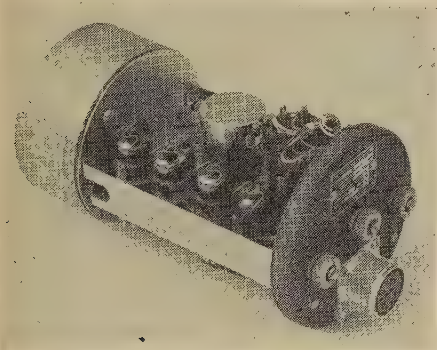
Model 2203 Dual Bellows Automatic Altitude Control features pair of pressure sensitive bellows operating in unison to provide greater resistance to vibration and shock. It is designed for effective operating altitude range of minus 1,000 to plus 50,000 ft. Light, compact, hermetically sealed, it is adaptable to any electronic autopilot system and is interchangeable with many existing automatic altitude control units. Altitude changes due to gusts or other conditions are automatically and smoothly corrected. Unit is housed in 4-inch sealed cylinder; weighs under 2 lbs. Models are available for 12-volt and 24-volt, 400- and 1150-cycle systems.

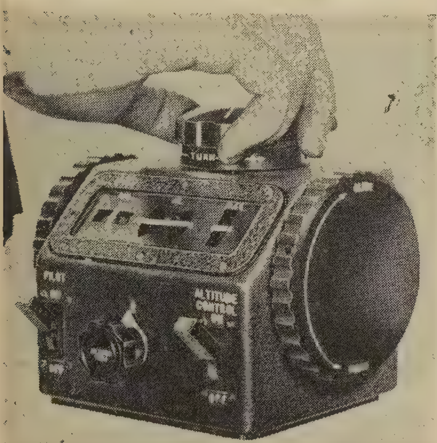


L-5 Airliner Autopilot offers simplified pilot control. Nucleus of L-5's performance are four buttons close to pilot's controller: automatic altitude control, release of altitude control, automatic approach localizer, and automatic glide path. Automatic altitude maintains altitude the pilot selects, regardless of turbulence or CG changes; Approach localizer operates within localizer range at destination (automatic approach coupler is triggered by signals from ILS so that aircraft automatically seeks and follows localizer beam on proper heading toward landing); when aircraft reaches point for final approach descent, pilot presses Glide Path button and autopilot locks onto electronic beam of the glide path to bring aircraft in toward runway in correct heading and attitude for visual landing by pilot. Continuous automatic trim is integral part of L-5. A sensing system provides automatic release of autopilot if malfunction occurs. Release button provides instant return to manual control of aircraft. Total representative installed weight with DC-3 accessory and installation kit, is 90 lbs. Power requirement: 110-volt, 400-cycle AC; 27-volt DC.

ARCON counteracts tendency of airplane to deviate from its heading; has no effect on pitch or roll. It is a gyro-servo combination that senses directional change, uses the resulting signal to make necessary rudder corrections continuously variable and proportional to amount needed to nullify incipient turn or spin and return airplane to straight-line flight. Unit can be installed

in any convenient space, usually aft of baggage compartment adjacent to rudder control cables. Master switch on instrument panel controls "off" and "on" operation. Arcon will not hold an airplane on a fixed course; its purpose is to damp and control magnitude of oscillation around yaw axis. With proper directional gyro, it will hold aircraft on relatively constant heading.



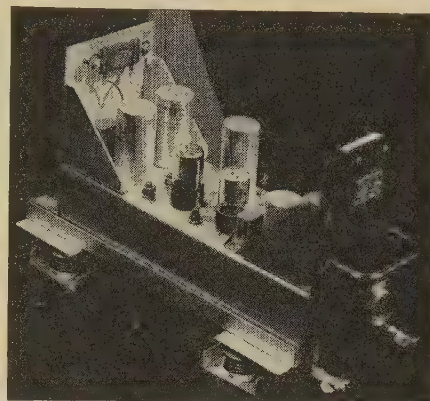


SPERRY GYROSCOPE CO.
Great Neck, L. I., N. Y.

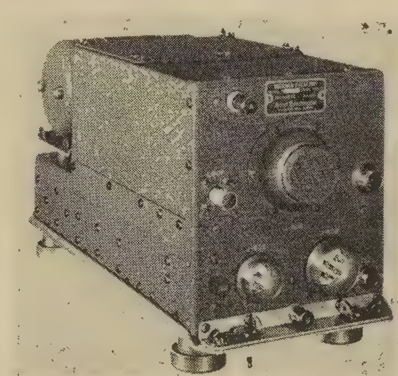
A-12 Precision Gyropilot offers reliable and accurate operation under all flight conditions. Components consist of Gyrosyn Compass Control and Flux Valve, Compass Repeater, Vertical Gyro Control, Pedestal Controller *(above)*, Amplifier, Servo Control, three Servos, and Elevator Trim Tab Servo. Optional equipment includes additional Compass Repeaters and Automatic Approach Control. Power requirements: Operates on 115-volt, 400-cycle AC; 28-volts DC. Total weight of installation is approximately 100 lbs.

WILCOX ELECTRIC CO., INC.
14th & Chestnut Sts.
Kansas City, Mo.

Computing Automatic Tracker, commonly referred to as the CAT system, is a device for insuring accurate ILS approaches. CAT tells the pilot when he's off course and how much to turn to get back on. It obtains heading and position information from the stabilized compass and localizer receiver equipment, and automatically computes a steering course signal for the pilot to follow. The CAT needle represents a beam that is actually a path to the runway, and keeping the needle centered insures an accurate and safe approach. Installation includes a CAT electronic unit mounted on a radio rack *(shown)*, switches for pilot control and test, and modification of a standard Omni-Bearing Selector instrument to furnish runway heading information. The equipment is turned on with the master radio switch. Components of the CAT system are: Standard Localizer Receiver; Stabilized Compass (Gyrosyn or Flux Gate); Runway Selector (combined with Omni-Bearing Selector); Computer unit; and Localizer Needle of ILS indicator (which becomes CAT needle when Deviation Indicator switch is in CAT position).



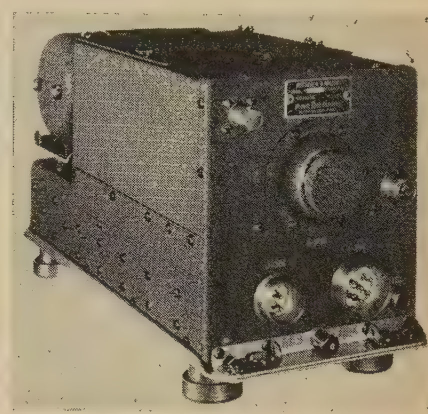
Communications & Navigation



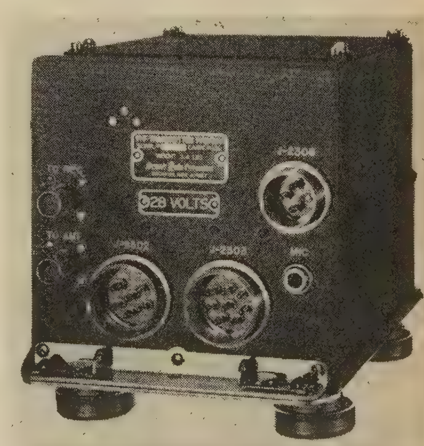
AIRCRAFT RADIO CORPORATION
Boonton, N. J.

The R-11A Receiver is designed for reception of LF radio ranges and for direction finding or homing in the 190-550 kc band. It may be used with ARC's R-10A Broadcast Receiver and L-10A Loop in lieu of a second ADF. The R-11A with M-12A mounting and D-10A Dynamotor weighs 9 lbs. Loop weighs 1.5 lbs., and two control units (C-16 and C-18), each under .6 lbs. Over-all dimensions: 4-15/16th wide x 6-7/16th high x 11-11/16th long. The equipment may be mounted in any convenient location in the aircraft and can be remotely controlled. Aural-null bearings with the L-10A loop on standard LF range stations up to 100 miles are sharp and well defined.

The R-19 VHF Receiver offers single- and multi-engine business aircraft strong, distinct and static-free voice signals. It is tunable over the entire VHF frequency band of 118-148 mc. R-19 weighs 8.8 lbs., including Dynamotor and Shock Mounting. Fidelity: AF output 25 db down at 30 cycles and 10,000 cycles, with respect to 400 cycles. Stability: Drift for temperature range of +50°C to —30°C at any frequency in the band, from three minutes after turning on the set to the time of maximum drift does not exceed 0.04%. Input voltage: 14 or 28 volts DC. Selectivity: 60 db down at 175 kc. VHF Antenna Type A-12 is recommended for aircraft having speeds up to 200 mph, so long as flight does not encounter icing conditions. This antenna fails quickly with ice. For aircraft operating under such conditions, the military "ax handle" AN-104B is recommended.



T-11B VHF Transmitter with the M-11A Mounting is specifically designed for business and private aircraft. Weighing 3.4 lbs., the T-11B provides 5 crystal-controlled frequencies in any 2-mc band from 116-132 mc. As many as four Transmitters may be installed, providing up to 20 channels. Transmitter Frequency Accuracy: Better than .01% as required by FCC. Power Output: Over 2 watts. Dependable Distance Range: 60 miles at 5,000 ft.; 100 miles at 10,000 ft. Input Current: 2.5 amps. at 28 volts; 5 amps. at 14 volts. For best over-all winter and summer operation, a stub mast antenna such as the AN-104B or equal is recommended.



R-20 Marker Beacon Receiver is a four-tube amplitude-modulation type Receiver designed for operation at 75 mc with modulations of 400, 1300 or 3,000 cycles. The audio output of the R-20 may be fed to the telephone circuit of the aircraft through a potentiometer. The "light" output is the 28-volt aircraft power supply which is switched on by a relay in the R-20. An expansion circuit narrows the cone of reception over a marker and gives sharp definition to the edges; it squelches the Receiver output when not over a marker.
(Continued on Page 36)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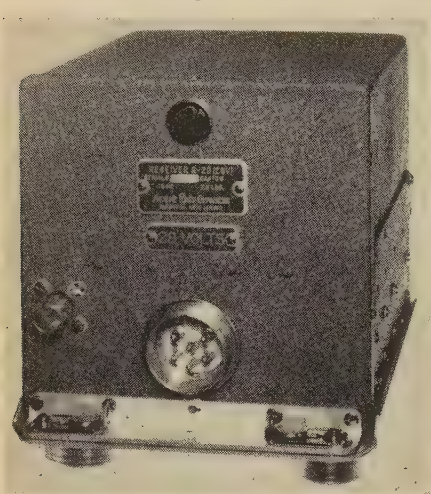
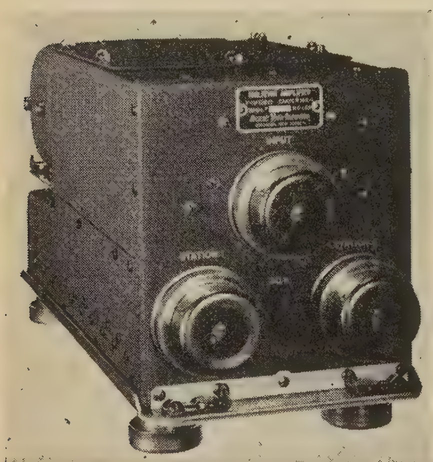
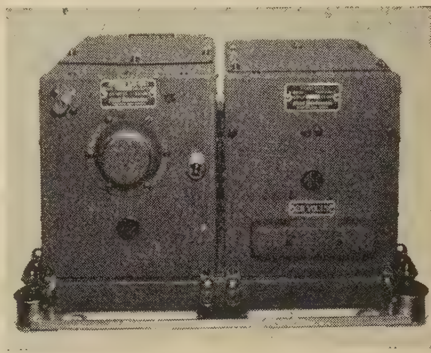
The R-20 has been designed for mechanical and electrical stability under extremes of temperature, humidity and vibration. Complete R-20 weighs 2.6 lbs., tnd operates from either a standard 74-inch wire or from a flush-type antenna. Flight tests made in the vicinity of high-power TV and radar stations indicate no spurious audio or visual responses.





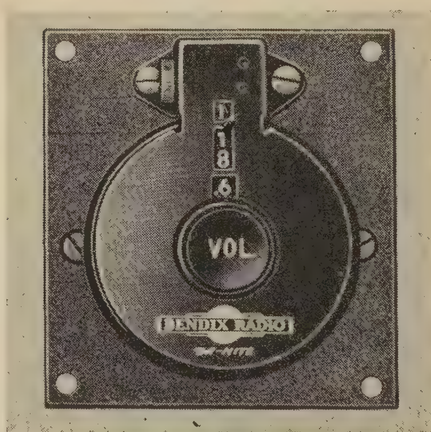
F-11A Isolation Amplifier gives each pilot independent selection of up to 10 audio input channels in any combination and without cross-cockpit interference. It operates individual cockpit speakers, with earphones instantly available if desired. To make possible a division in the cockpit work load, as many as 18 signals may be connected into the F-11A in such a way that 8 special signals are routed to the pilot only, 8 to the copilot only, and 2 common to both. Complete circuit isolation permits independent operation by pilot or copilot without interference to each other. The F-11A weighs 8.3 lbs. (including the shock mounting), and is available for either 14 or 28 volts.

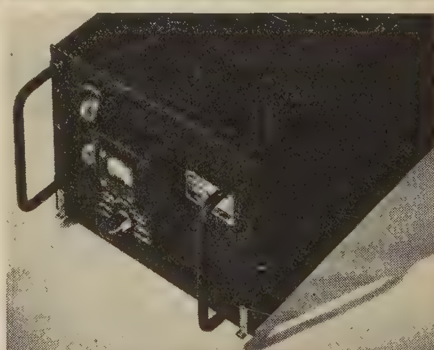
Type 15D VHF Navigational Receiving Equipment has been designed for single- and multi-engine airborne reception of runway localizers, visual-aural ranges, omni-directional ranges, simultaneous voice and GCA voice. Major units include an R-13B VHF Receiver for reception of signals in the 108-135 mc band; a B-13 Converter which interprets signals and actuates the Course Selector or the Cross-Pointer Meter; and an A-13B VHF Navigational Antenna, a development of the military "ramshorn" antenna. Input Power Required: 2.8 amps. at 28 volts DC or 5.6 amps. at 14 volts DC Complete installation weighs about 25 lbs.



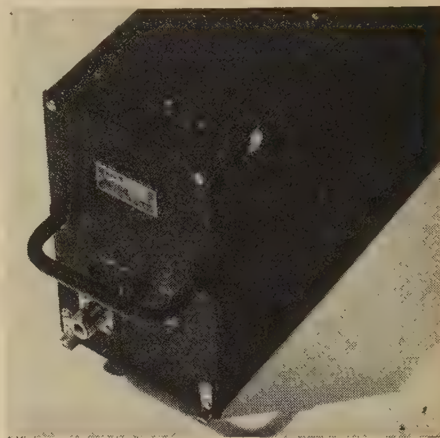
BENDIX RADIO
2122 N. Charles St.
Baltimore, Md.

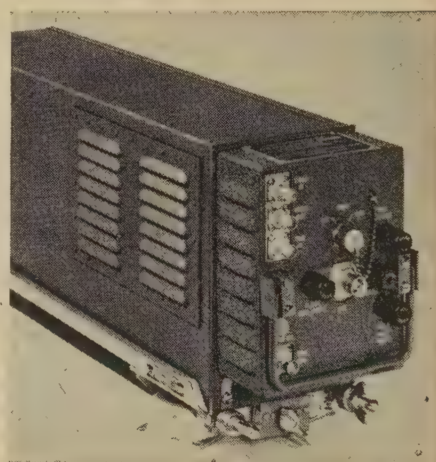
Type TA-18BB VHF Transmitter is capable of crystal-controlled transmission on each of 360 channels between 118.0 and 135.95 mc. Frequency Stability: Better than .005% in ambient temperature of —30°F to +130°F. Power Output: 25 watts or more to a 52-ohm resistive load at any frequency within range. By rotating pair of concentric knobs of the Type MN-81 control unit, any of the 360 channels may be selected in less than 3 seconds. High power output and stability assure maximum range and reliability. The TA-18BB, less MT-117B Shock Mounting, weighs 43 lbs.





RA-18B VHF Receiver is designed as a companion unit for TA-18BB VHF Transmitter. It provides crystal-controlled reception on 360 channels spaced 50 kc apart in the frequency range of 118.0 to 135.95 mc. Selection of the desired freq is accomplished via a simple "finger-tip" control panel located in the cockpit. This control panel is calibrated directly in frequency and is illuminated by the Bendix "DA-NITE" system which provides white lighted numerals at night. The RA-18B is designed to operate from a 27.5-volt DC or 115-volt AC primary power source.

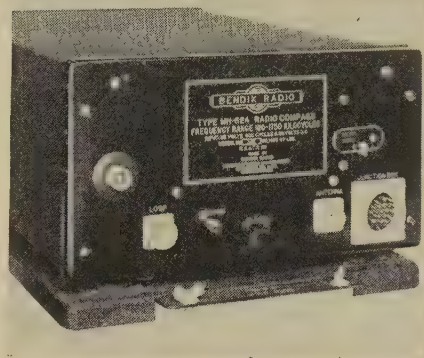




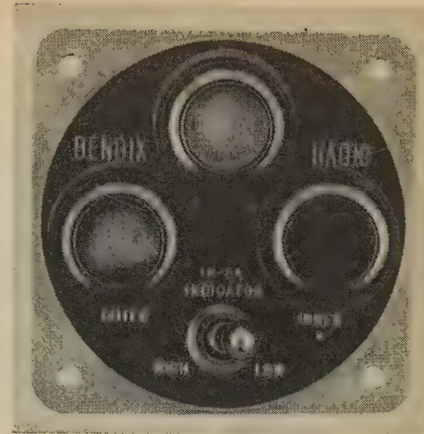
DME-5 Distance Measuring Equipment computes distance of an aircraft from a combined DME/VOR station, and the distance is shown in miles on a range indicator. Components of the system are the DME-5A Interrogator unit (weighs 29 lbs.), the DMI-5A Range Indicator (2 lbs.), and the ANT-5A Antenna (.25 lbs.). Power requirements: 250 watts at 27 volts DC; 25 watts at 115 volts AC (400 cps); and 85 watts at 115 volts AC (380-1,000 cps). Maximum Range: 200 nautical miles. Accuracy: 0.5 nautical miles or 3%, whichever is greater. Range Indicator Calibration: 0-40 miles; 0-200 miles. Maximum number of Range Indicators: 3. Interrogation Frequency Range: 960-987.5 mc. Reply Frequency Range: 1187.25-1215 mc.

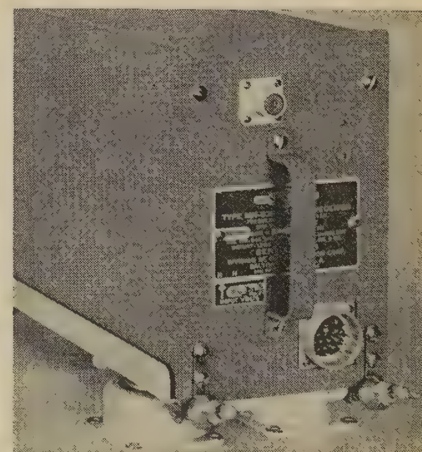
NA-1 Navigational System Consists of a highly flexible array of equipment designed to meet all requirements for automatic direction finding. Components for an NA-1 single ADF system installation include the MN-62A receiver *(shown)* which covers the frequency range of 100-1750 kc in four bands (No. 1, 100-200 kc; No. 2, 200-410 kc; No. 3, 410-850 kc; and No. 4, 850-1750 kc); MN-63A remote controls, MS-92A Jack Boxes, the MN-60A Iron Core Antenna, one or two bearing indicators (MN-37B, MN-44B, MN-58C [*shown*],

MN-42C), one or more headsets, one or more range filters, necessary right-angle drives, a junction box, cables, and r.f. transmission lines for loop and antenna. Necessary components for the NA-1 Dual ADF system include (for pilot only) two receivers, two remote controls, jack boxes, range filters for each jack box, two automatic loops, a dual bearing indicator, a junction box, one or more headsets, any necessary right-angle drives, two transmission lines and connecting cables and mechanical shafting. A 115-volt, 400-cycle AC power source is required to operate each System. If this is not available, 14 or 28-volt inverter power units must be supplied (one is required for the NA-1 Single ADF System; two for the Dual System). If a 14-volt installation is desired, it will be necessary to order, in addition to the 14-volt AC inverter unit, a Type MP-47A power unit to develop 28 volts DC for relays in the MN-62A receiver. The MN-62A has receiver, compass and loop control circuits, with intermediate frequency 243.5 kc on Band 1, and 142.5 kc on Bands 2, 3, and 4. Power Output: 500 milliwatts. The MN-62A Radio Compass Receiver, complete with shock-mount, mounting base and tubes, weighs 54 lbs.; the MN-60 antenna weighs 16.75 lbs., including housing.



Type MN-53B Marker Beacon Receiver is designed for visual and aural reception of 75 mc "Z" Marker, Fan Marker, and Inner and Outer Marker signals modulated at 3,000, 1300 and 400 cycles per second. Audio frequency output at the three tone frequencies is used directly to heat the filaments of the three indicator lamps on the Type IN-5 Indicator, eliminat-





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CESSNA 310

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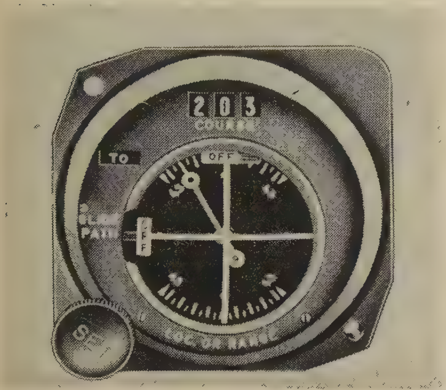
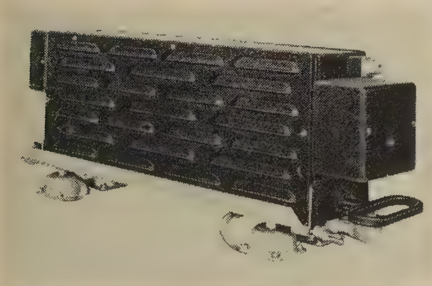
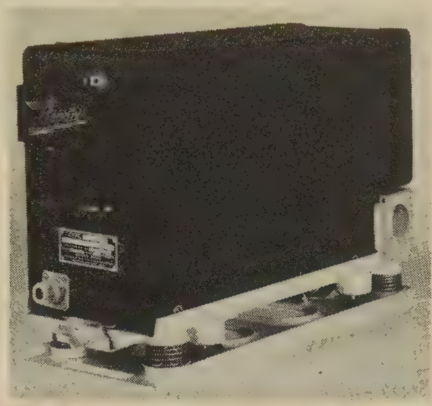
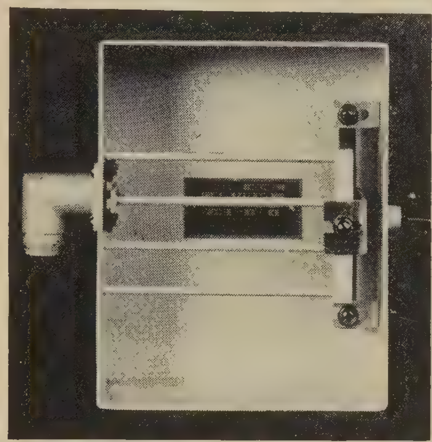
ing the need for saturable reactors, relays, etc. A white lamp at the top center of the IN-5 Indicator gives visual indication of a steady 3,000 cps tone, indicating reception of Airways "Z" Marker signals. The same lamp also gives a visual indication of a 3,000 cps keyed tone (dashes) when receiving an Airways Fan Marker signal. An amber light on the right gives visual indication of the reception of an Inner Marker signal; and a purple lamp on the left indicates reception of an Outer Marker signal. Power Requirement: All low voltage circuits are designed so that the receiver may be operated on either 13.25 or 27.5 volts. The unit weighs 11-9/16 lbs.; is shock-mounted on MR-64C Mounting.





NA-3 VHF Navigation System allows the pilot full utilization of all airway navigation, instrument landing and communications facilities currently available between 108 mc and 135.9 mc. Two hundred and eighty crystal-controlled frequencies are selected via knob switch located in the cockpit. Navigation information is presented to the pilot in a cross-pointer instrument in which a vertical pointer is at center when the aircraft is directly on desired course. An important component of the NA-3 System is the MN-97 Omni-Mag which presents the flight information that previously was presented by several indicators. The Omni-Mag minimizes the mathematics of an omnirange or ILS orientation problem and, in an approach, shows the pilot a continuous "motion picture" of the selected track and aircraft heading and position as related to that track. The ID-48 Course Deviation Indicator shows course deviation in conjunction with VOR, VAR or ILS. The horizontal pointer gives a glide path indication. Heart of the NA-3 System is the MN-85 VHF Receiver covering 108-135.9 mc. The antenna, MS-192, is horizontally polarized and designed for reception of VHF navigation and runway localizer signals. The MN-85 VHF Receiver weighs 27 lbs., 10 oz.; the MR-74 Shock-mount weighs 3 lbs., 4 oz.; the ID-48 weighs 1 lb., 9 oz.; the MN-97 Omni-Mag weighs 3 lbs., 4 oz.; and the MS-192 antenna weighs 5 lbs., 12 oz. The MN-81 Remote Control frequency selector used with the NA-3 System weighs about 2 lbs.

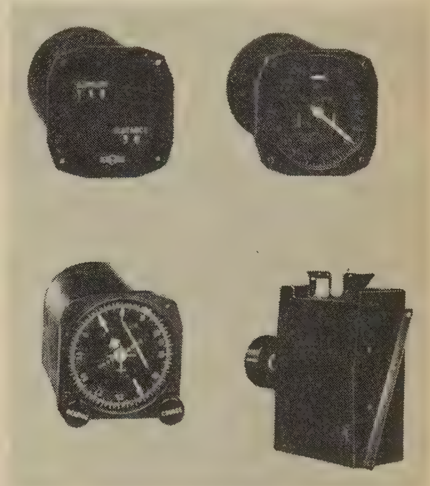




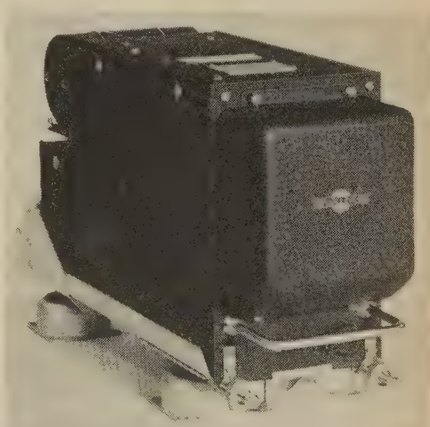
Type MN-100A Glide Slope Receiver is a 20-channel fixed-frequency receiver designed to receive 90/150 cps tone-modulated glide slope information to produce vertical guidance during ILS operations. Frequency Range: 329.3-335.0 mc. Channel Spacing: 300 kc. Power Supply: High-voltage power supply is built into the receiver and requires 115-volt, 320-1,000 cycle AC at .25 amps. The receiver also requires 27.5-volt DC at 1.1 amps. for tube filament and relay supply. The unit weighs 12.8 lbs. The MN-92A Glide Slope antenna *(shown)* was designed for use with MN-100A Glide Slope Receiver. Characteristic impedance: 52 ohms. Weight: 1.5 lbs. Dimensions: 6 inches wide x 5.062 high x 2.25 inches deep.

COLLINS RADIO CO.
Cedar Rapids, Iowa

NC-101 Navigational System is a punched-card operated system. Components are an air-borne computer (Type 560D) designed to enable a pilot to fly a selected course line to any chosen waypoint or destination (the waypoint or destination need not have radio facilities; it is only necessary that the aircraft be within the service area of any two radio stations or an omnirange-distance station): a Waypoint Selector (386A); a Course Indicator (331A); a Distance Indicator (339B); and a Card Reader (385A). The NC-101 System Indicates deviation from the chosen course line in a pictorial presentation on the Course Indicator; it gives distance to or from waypoint on a Distance Indicator; it tells whether the distance indicated is the distance to or from the waypoint or destination; it automatically tunes the VOR receivers involved and supplies pre-coded input reference data necessary for the computation (station frequencies and navigation reference information are entered into the computer by a compact punched-card reading device). When used in ILS approaches, the NC-101 System indicates distance to touchdown on a 0 to 15 miles full-scale Distance Indicator; it warns of improper function due either to low signal strength or the position of the aircraft being approximately in a straight line with the two stations. Power Source: 115 volts, 400 cycles, 45-volt amps., single phase and 28-volt DC, 1.2 amps. Total weight of the NC-101 Navigation System is approximately 43 lbs.



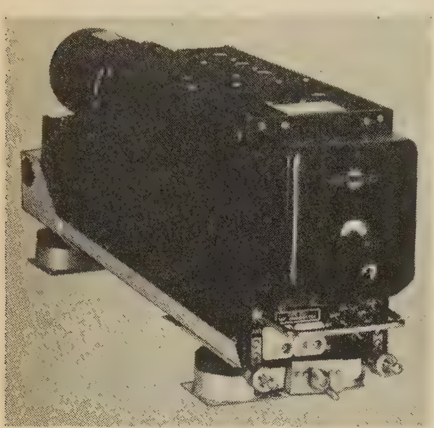
MC-101 Gyro Stabilized Magnetic Compass features magnetic amplifiers, improved load capabilities for automatic approach devices, instruments, etc., and improved sensitivity; weighs about 17 lbs.

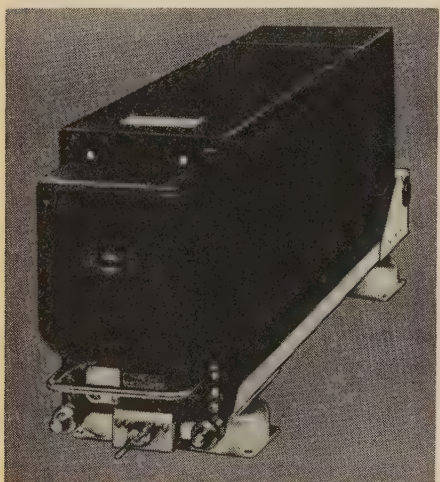


Type 17L-3 VHF Transmitter has a frequency range of 118.0 to 135.9 mc, and all of the 180 channels assigned in this range are easily selectable over a remote control system. It is intended as a companion to the Type 51R Receiver. Power output of the 17L-3 on radio-telephone is rated at 8 watts. An antenna changeover relay is included in the Transmitter for switching the VHF antenna between trans-

(Continued on Page 40)

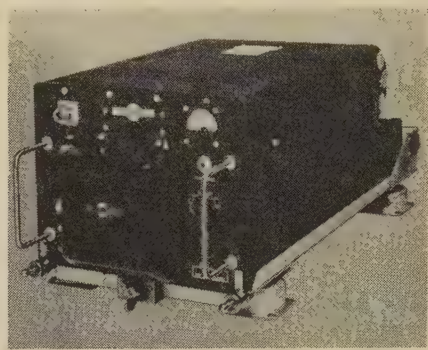
mitter and its companion Receiver. The Transmitter audio system is capable of 90% modulation of the carrier on voice. The modulator is designed to operate with a standard carbon microphone. Power Requirements: Standby, transmitter only, 1.0 amps. at 26.5-volt DC; Transmitting, 7.5 amps. at 26.5-volt DC. Weight of the Transmitter: 22 lbs.



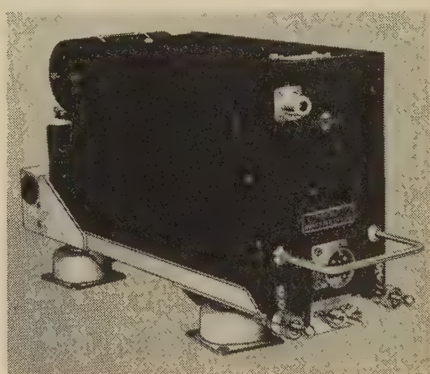


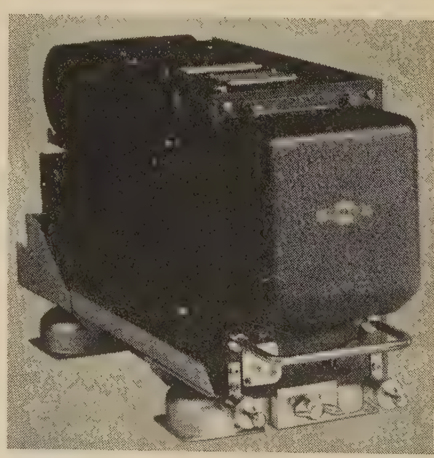
51X VHF Receiver operates in the frequency range of 118.0 to 135.9 mc with 50 kc spacing. Sensitivity: Signal to noise ratio for 2 microvolt signal modulated 30% at 1,000 cps is 6 db or better. Automatic Volume Control: Audio output will not vary more than 3 db when the input signal is from 5 to 100,000 microvolts, and not more than 6 db with an input signal from 5 to 500,000 microvolts. Output Level: Aural output (nominal 100 mw) adjustable to user's requirements by self-contained locking type potentiometer. ATC Signaling Output, 0.5 volts RMS across 1,000-ohm output circuit. Ambient Temperature Range: —40° C to +70° C. Ambient Humidity Range: 0 to 95% relative humidity. Altitude: Sea level to 30,000 ft. Power Supplies: Dynamotor type requiring 27.5-volt DC, or Transformer/Rectifier type requiring 115-volt 300-1,000 cps AC and 27.5-volt DC. Weight: Receiver with power supply, including shockmount, 31 lbs.

17M-1 VHF Transmitter is a high-performing companion to the 51X Receiver. It is a 40-watt unit designed for VHF air-to-ground communications utilizing 360 separate, crystal-controlled channels over the 118.0 to 135.9 mc frequency range. The Collins Autopositioner system is employed for automatic frequency selection and tuning. A coaxial relay in the transmitter switches the antenna from the receiver to the transmitter when the 17M is operated. Power Output: 40 watts nominal into a 52-ohm resistive load. Power Input: Nominal voltage 27.5-volt DC. Current Requirements: Standby 2.3 amps., Transit 17.5 amps. Frequency Stability: Carrier frequency does not deviate from assigned channel frequency by more than 0.005% under service conditions. Undesired Radiations: Harmonics are at least 60 db below desired frequency. Weight: 40.4 lbs.

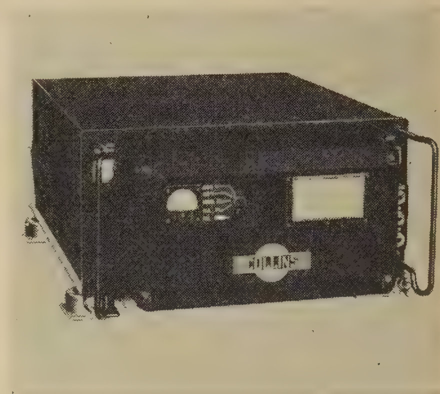


51Z-1 Marker Beacon Receiver provides visual and aural indication (via 327A-1 Indicator) of flight over a 75-mc fan marker. It is crystal-controlled, superheterodyne receiver for fan marker signals amplitude modulated at 400, 1300 or 3,000 cps. Dynamotor power supplies are used for 27.5 and 13.75-volt DC operation. A tube rectifier power supply is available for AC operation.

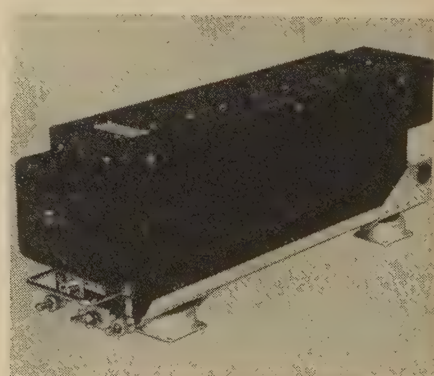




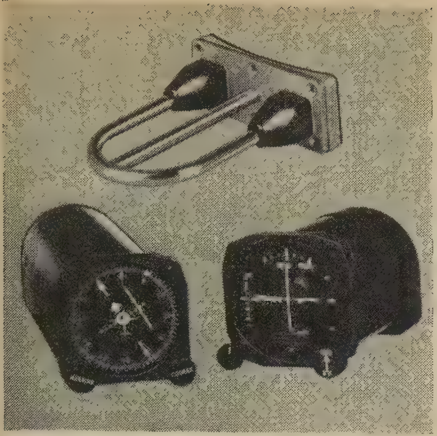
51V-2 Glide Slope Receiver receives 90/150 cps tone modulated glide slope signals on any of 20 channels of UHF range 329.3 to 335.0 mc. Remote selection of any of glide slope channels is provided in the cockpit. Type 51V Receiver utilizes high-voltage DC plate and screen supply from self-contained dynamotor or 400-cycle AC power unit. Use of appropriate dynamotor or AC power unit makes Receiver operable from 27.5-volt DC source or 115-volt, 300-1,000 cycle AC source with 27.5 volts DC for relays and filaments. Antenna is Type 37P mounted horizontally on nose of aircraft. 51V-2 weighs 15 lbs.



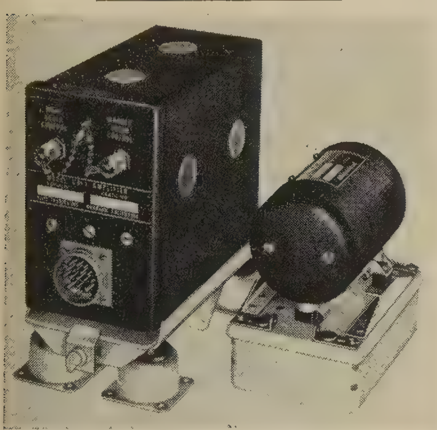
618S Transceiver provides transmitting and receiving facilities for 144 channels assigned in the 2.0 to 25.0 mc frequency range. Full power transmitter output of 100 watts is available throughout frequency range. All circuits are tuned automatically, and the Collins 180L-2 automatically makes all antenna adjustments. Type of Frequency Control: Quartz crystal, CR-18/U; only one crystal required for both transmitting and receiving. Cross-band operation possible by changing frequency selection control. Input Power Requirements: All voltage obtained via 416W Power Unit. Altitude Ranges (Transmitter section): Full power operation up to 50,000 ft. Weight: 51 lbs., without shockmount; 60 lbs. with shockmount.



51R-3 Navigation Receiver uses the 108 to 136 mc band and provides for Omni, ILS and VHF communications. In addition, the channel selection circuits of the 51R-3 are arranged to accommodate addition of Glide Slope Receiver, thus affording choice of appropriate localizer and glide slope channels from a single control unit. With the 17L or 17M transmitters, the two units offer two-way VHF voice communications. Only 34 crystals are employed in the 51R-3 to provide complete 280-channel coverage. Can be wired for TVOR, 108 to 112 mc. Weight: 29-1/2 lbs.

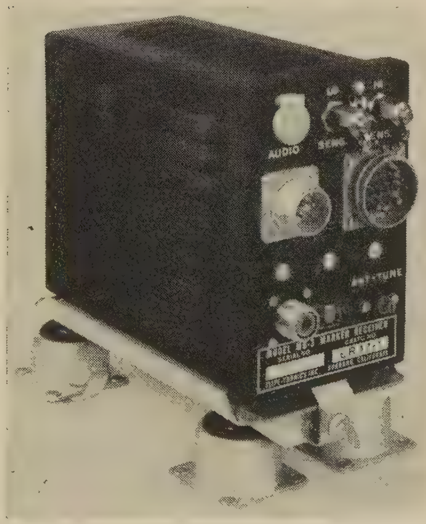


Integrated Flight System employs the 51R Navigation Receiver, the 51V Glide Slope Receiver, the 562A Steering Computer, the 332D Vertical Gyro, the 329B Approach Horizon, the 331A Course Indicator, the 37P Glide Slope Antenna for UHF range, and the 37J VHF Navigation Antenna. The IFS greatly simplifies ILS approaches and cross-country navigation. Use of the 329B Approach Horizon and 331A eliminates need for the older conventional cross-pointer and omni-bearing selector. Weights: 51R Navigation Receiver—29-1/2 lbs.; 51V Glide Slope Receiver—15 lbs.; 562A Steering Computer—12.5 lbs.; 332D Vertical Gyro—4.5 lbs.

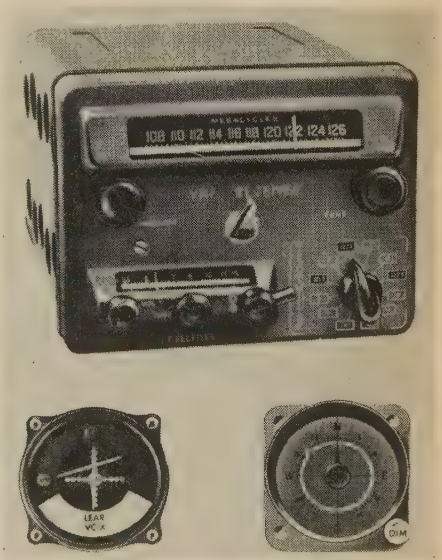


FLITE-TRONICS, INC.
3303 Burton Ave., Burbank, Calif.

CA-1 Audio Amplifier is new lightweight multiple-channel amplifier supplied with up to 10 internally isolated channels for use with general aircraft radio equipment, plus an individual marker audio channel. Features include use of one type amplifier in any size aircraft and isolated input circuits to eliminate need for matching to various makes of receivers. Provision is made for reception of single or mixed simultaneous voice, marker, range or other audio signals on one or more loudspeakers or earphones. Special time delay muting of marker channel is incorporated. Marker muting delay lasts 30 seconds, allowing enough time for communication with tower while still releasing marker audio in time to catch next marker; does not affect visual marker indication. Muting is done by pressing mike button for transmitting, lasts 30 seconds after mike button is released. CA-1 is designed as matched equipment to MB-3 Marker Beacon Receiver. Complete cockpit isolation between pilot, copilot is accomplished by using two CA-1's. Weight: Approximately 3-1/4 lbs. Power Output: Over 7 watts. Cost: $278.01, including amplifier, shockmount, power supply, plug.



MB-3 Marker Beacon Receiver is adaptable to 12- or 24-volt systems and gives equally high performance with any of popular types of antennas. Normal impedance of 50 ohms is only requirement. MB-3 offers accurate detection of tone or voice-modulated 75-mc signals through aural and visual indications for modulation tones of 3,000, 1300 or 400 cps. Adjustable sensitivity is supplied in two ranges, high and low; simplicity of color-coded circuits eliminates troubles inherent in superheterodyne circuits. Weight: Slightly over 7 lbs. Cost: $471, including receiver, shockmount, indicator and power supply.



LEAR, INC.
11916 West Pico Blvd.
Los Angeles 64, Calif.

Model LTRA-6 Omnimatic System consists of the following units which provide full two-way communication, a LF receiver and automatic Omnirange navigation: RT-10E VHF Transmitter, a 2-watt,

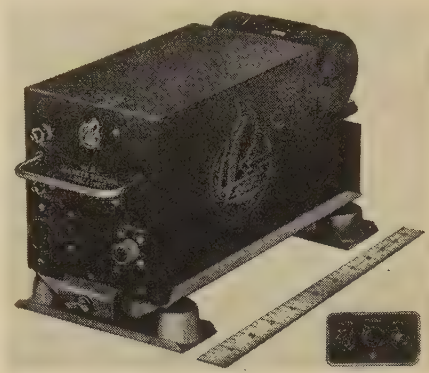
(Continued on Page 42)

12-channel, crystal-controlled transmitter with 5-mc band spread; LR-6 VHF Tunable Receiver which offers continuous frequency coverage from 108 to 127 mc and receives all ILS localizers, VAR stations, VOR stations, CAA INSACs, control towers and Unicom transmitters; LRA-6 LF Receiver which provides reception of standard broadcast (550-1600 kc) and range (200-400 kc) bands including automatic reception of aural 75 mc marker beacon transmissions; and the Omniscope which automatically gives the pilot a continuous visual magnetic bearing to and from the omnirange station. The Omnipack Converter Power Supply and Omnitenna, plus installation accessories, complete the system. Total installed weight is under 24 lbs.

Model LTA-6 is a VHF transmitter (RT-10E) and an LF receiver (LRA-6) combined with 75 mc Marker Beacon receiver. It uses the LDMR power supply. A Model LR-6 slide-rule dial VHF Receiver can be added if desired.

Model LTTR-6 offers dual VHF Transmitters with a VHF Receiver. Two 2-watt RT-10E's provide 24-channel capacity combined with a tunable (LR-6) receiver. The Omnimatic can be added to this system. Lear's flexible building-block radio units make possible 18 different combinations, from primary to complete systems.

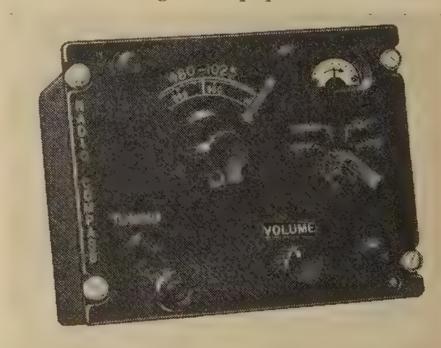
Model 2200 Marker Beacon Receiver incorporates a unique plug-in dynamotor arrangement which makes the receiver independent of associated equipment. Both visual and aural output can be utilized to operate headphones or to work into a standard 500-ohm amplifying system. Provision also has been made to operate a loudspeaker. Model 2200 is available in two models: one having both visual and aural outputs, and a lower priced unit having aural output only. Both models are available for 12- or 24-volt systems. Weight: Aural and Visual type—10-1/2 lbs.



LTRA-6P is a portable VHF transmitter-receiver combination which provides two-way VHF air-ground communications. It weighs about 22 lbs. and is completely contained in an all-metal carrying case. It consists of a tunable VHF Receiver with a frequency range of 108 to 127 mc, a 2-watt, 12-channel, crystal-controlled VHF Transmitter with a frequency range on any 4 mc band from 118 to 150 mc, and a Standard broadcast and range band LF Receiver. A 75 mc Marker Beacon Receiver is also incorporated. LTRA-6P is available for 12- or 24-volt system and has a self-contained dynamotor power supply.

LVTR-36 is self-contained, remotely operated, two-way VHF communication system. It consists of a 5-watt, 36-channel VHF transmitter, a 36-channel VHF receiver, and a remote frequency selector switch that mounts on the instrument panel. LVTR-36 permits radio transmission and reception automatically on same frequency with single setting of selector by pressing and releasing mike button. If desired, Transmitter may be installed alone, with Receiver added at a later date. It is available for 12- or 24-volt operation. Total weight of LVTR-36, including shockmount, is less than 17 pounds.

ADF-R14B is new remote radio compass that provides civilian pilots with remote controlled ADF equipment designed to conform with military specifications in size, weight and performance. System includes shockmounted amplifier, shockmounted tuner, azimuth indicator (dual or single), a Ferro Dynamic loop, and remote control console. The remote control features eyeeze edge lighting, has shutter-type dial, a frequency selector covering three bands: 195 to 400, 475 to 1050, and 1000 to 1750 kc. It is available for 12- or 24-volt operation. Total weight of equipment is 25.1 lbs.



ADF-14 is a heavy-duty radio compass or automatic direction finder designed for multi-engine aircraft. It is redesigned version of the ADF-12. Unit consists of four basic components: the tuner, shockmounted amplifier, an azimuth indicator, and the hermetically sealed loop which is smaller

(Continued on Page 44)

ELIMINATES UNNECESSARY STRUCTURAL INSPECTIONS!

General Mills Flight Recorder gauges stress of air turbulence and hard landings

Here's a compact, lightweight instrument that ends costly guesswork in ordering structural inspections of aircraft. The General Mills Flight Recorder provides an accurate continuous measurement of vertical acceleration encountered during flight. With it, you can immediately determine whether unusual turbulence or a hard landing has made inspection necessary. In addition, the recorder supplies statistical information of value in checking your operational and safety standards.

The recorder employs no electronic circuitry, thus offers a high degree of reliability, low maintenance and repeatability.

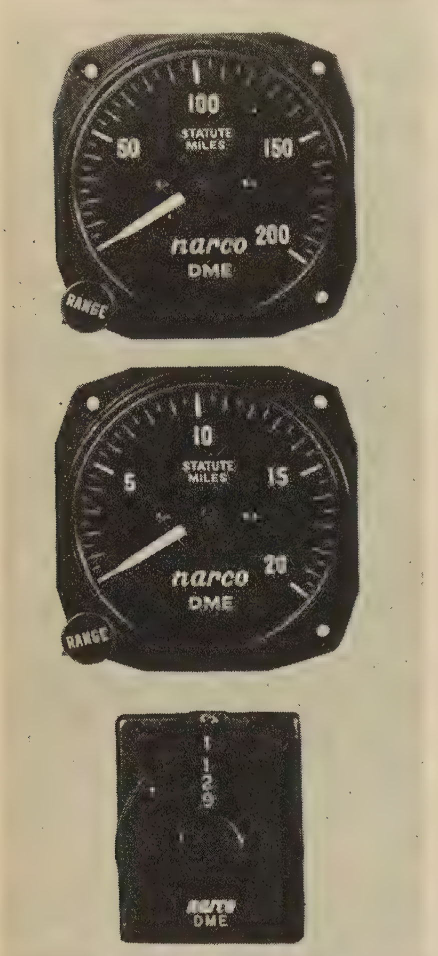
✓ CHECK THESE FEATURES OF THE GENERAL MILLS FLIGHT RECORDER

- ☐ Records altitude, airspeed, vertical acceleration, direction of flight and time.
- ☐ Record is protected to withstand a 2,000°F fire for a half hour, shocks up to 100G.
- ☐ Weight is about half that of other commercial recorders measuring the same functions.
- ☐ Recorder continues to operate for a minimum of 10 minutes following power failure.
- ☐ No electronics — provides reliable results with a minimum of maintenance.
- ☐ Embosses a continuous 300-hour recording on aluminum foil — a direct, permanent record that requires no photographic processing or magnetic playback.
- ☐ No remote sensing pickups required.

Further information on the General Mills Flight Recorder will be gladly sent on request. Write today to: Equipment Sales Dept., Mechanical Division, General Mills, Inc., 1620 Central Ave., Minneapolis 13, Minn. *Foreign Representative:* Air Carrier Service Corp., 1744 G St. N. W., Washington 6, D. C.

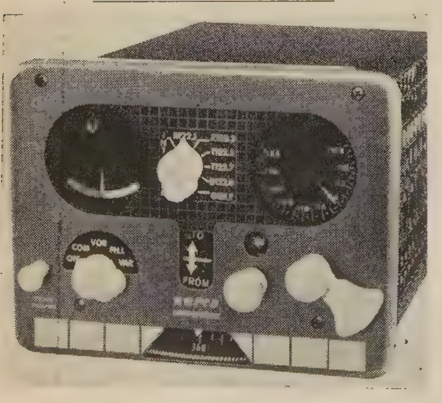
Mechanical Division
General Mills, Inc.
1620 CENTRAL AVE. • MINNEAPOLIS 13, MINN.

than previous types and permits flush mounting. Frequency Range: 190 to 430 kc; 480 to 1025 kc; and 1025 to 1725 kc. Compass Sensitivity: (plus or minus) 2° at 25 mc per meter. Power Output: 3 watts maximum; 1-1/2 watts undistorted. Power Consumption: Maximum, 3 amps. at 24 volts; 5.8 amps. at 12 volts. Weight: 19 lbs.



NATIONAL AERONAUTICAL CORP.
Ambler, Pa.

Model UDI-1 DME gives pilot direct indication of his distance in miles from any VOR station or ILS equipped with DME. This information is given in two scales: enroute scale, 0 to 200 miles, or approach scale, 0 to 20 miles. Pilot chooses scale by turning knob on face of panel-mounted indicator. UDI-1 employs crystal tuning, eliminating frequency alignment procedures. Main interrogator unit mounts on standard one-half ATR rack.



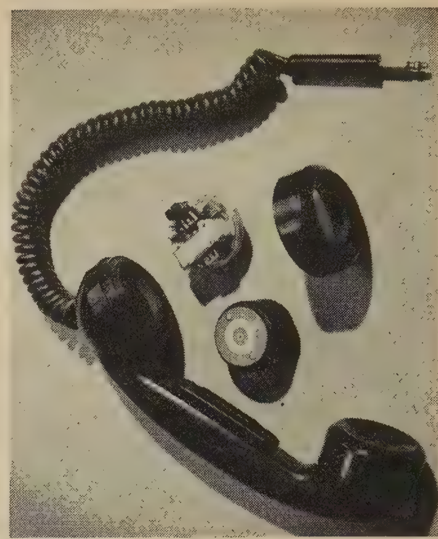
Omnigator comprises an 8-channel VHF transmitter and a VHF receiver (108 to 127 mc range). Three crystals are supplied as standard. Omnigator also incorporates a 75 mc Marker Beacon receiver. It operates on ILS localizer and VAR ranges, and provides accurate omni-navigation with two separate "To-From" and "Left-Right" indicators. Total weight, including separate power supply and antenna, is 18.5 lbs.

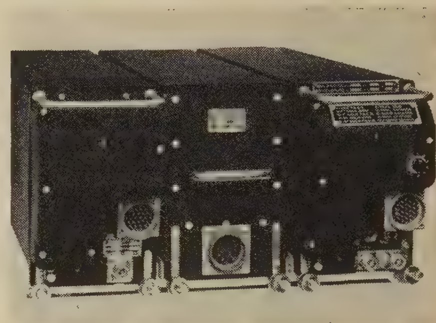
Superhomer is a high-performance, single-unit VHF radio incorporating a 4-channel transmitter (2 crystals supplied as standard), a tunable VHF receiver for 108 to 127 mc reception, and a vernier Omni course selector. The "Left-Right" needle also serves as "To-From" indicator. Total installed weight, including antenna and lead-ins is 10-1/2 lbs.

Simplexer is a 12-channel VHF transmitter and receiver serving as a primary communications unit. It is sometimes used as an auxiliary transmitter to provide additional channels and a second independent communications system for business aircraft. Feature is "whistlestop" tuning of wide-band VHF receiver which permits positive tuning to any simplex frequency without looking at tuning band. Simplexer can employ power supply of the Omnigator or a choice of independent power units. Weight of unit itself is 2.8 lbs.

REMLER CO.
2101 Bryant St.
San Francisco, Calif.

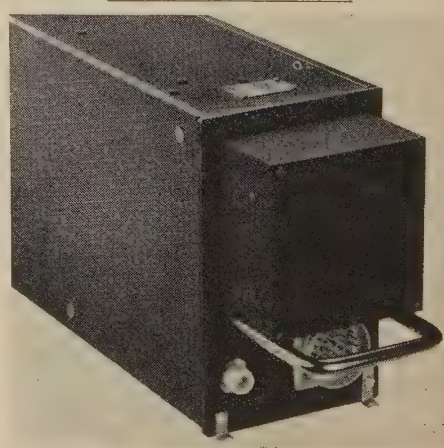
Model A-257 Transluctance Microphone (hand-held type) is no larger nor heavier than comparable carbon types. Remler Transistor-Magnetic microphone offers noise-free fidelity and permits direct interchangeability in carbon microphone circuits. Microphone driver unit is variable reluctance type designed for high speech intelligibility. Matched Impedance: 150 ohms, —1 db 50 to 500 ohms. DC Supply Load: 1000 ohms between 5 and 35 volts DC. Handset model also is available.





WILCOX ELECTRIC CO.
Kansas City, Mo.

Model 404A Communications System offers both a transmitter and receiver covering 180 channels in the 118 to 136 mc band (100 kc separation). Only crystals for present requirements need be installed; others may be installed as needs arise. Transmitter and Receiver functions, including frequency selection, are available by remote control. Cross-band operation is available through use of two channel selector switches, permitting independent frequency control of the transmitter and receiver. Power Output of 50 watts increases dependability of Transmitter. Transmitter weight: 22 lbs., 6 oz. Receiver Output Impedance: 500 ohms. Audio Output: 300 mw at 1,000 cycles, 30% modulation. Weight: 21 lbs., 4 oz. Power Supply weighs 28 lbs., 7 oz.

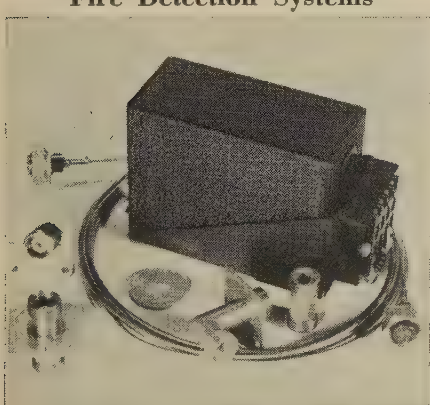


429 Glideslope Receiver is engineered to provide reliable 90/150 cps tone modulated glideslope signals for ILS. All 20 frequencies in the UHF 329.3 to 335 mc navigational band are provided. Automatic gain control circuit provides improved stability of glideslope indication. Reduction of ripple interference due to power supply variation is made possible through introduction of out-of-phase components of ripple voltage into audio system. Receiver is supplied for operation on 110-volt, 400-cycle AC, or 12- or 26-volt DC.

ARMA CORP.
Long Island City, N. Y.

Pictorial Computer shows pilot, continuously and automatically in all weather, his aircraft's exact location and heading on a projected map. Range, bearing and heading information are automatically combined into an instantly understandable unit. The Pictorial Computer takes bearing from the aircraft's navigation receiver, range from its distance measuring device, and heading from its gyro compass. Display unit weighs 25 lbs.; Amplifier, 21 lbs.

Fire Detection Systems

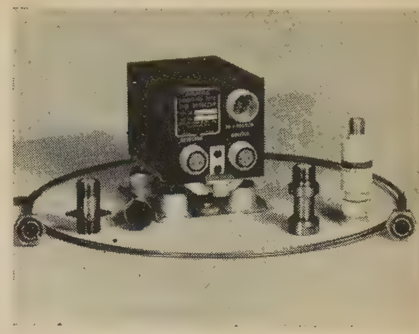


THOMAS A. EDISON, INC.
Instrument Division
West Orange, N. J.

Fire Detection System devised by Thomas A. Edison, Inc., features continuous element sensitive to heat at all points along its length, thus eliminating "blind" spaces existing in single-point detectors. Components include sensing element, control box which operates from aircraft's primary power supply (28 volts DC), and accessories. Special feature is the elimination of false alarms; it is also fail-safe. Response time: in tests, system responded within 2 seconds when 6 inches of cable were exposed to a flame of 2,000°F.

WALTER KIDDE & CO., INC.
Belleville, N. J.

Continuous Resetting-Type Fire Detector System comprises a continuous, wire-like, fire-sensing element connected at one end to a monitoring control unit which provides power for the system and the electronic circuit for actuating audible and/or visible alarms located on the pilot's instrument panel. The system is designed for operation with 115-volt, 400-cycle, one-phase current normally available in aircraft electronic instrument circuits. Normal standby power consumption of 8 watts; maximum power consumption during fire-warning signal is 30 watts. Complete single-engine detecting system provides simultaneous coverage in engine Zones 1, 2, and 3; is easily installed; requires almost no maintenance. System weighs 4 lbs.; costs about $400 per engine.



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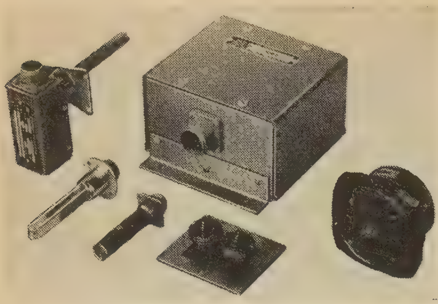


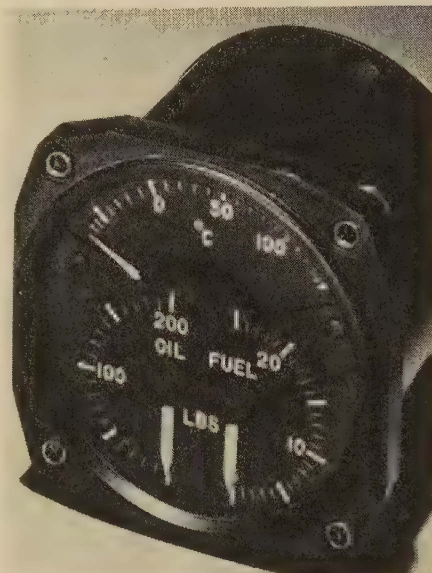
BARBER-COLMAN CO.
Rockford, Ill.

Heat Cycling Control System maintains a constant selected cabin temperature. The relative resistance of temperature sensitive element located in the cabin air, heater discharge air, and outside air automatically cycle the combustion heater in accordance with cabin demands. Cabin temperature is selected on a rheostat calibrated from 60° to 80°F. A high limit thermostat provides overheat protection. The system consists of a control box containing the Micropositioner, secondary relay, fixed resistors, and calibration and frequency rheostats; a temperature selector; cabin air element; heater discharge air element; outside air element; and high limit thermostats. Total weight is 3-3/4 lbs.

ECLIPSE-PIONEER
Teterboro, N. J.

Type 1426 Airspeed Indicator is sensitive, differential pressure gauge which measures difference between static pressure and impact pressure created by forward velocity of the aircraft. Instrument is available in mph (40-300; 50-450; 50-700), knots or km/hr. Will operate satisfactorily to low temperature of —65°F. Instrument weighs 0.7 lbs.

Type 1634 Rate of Climb Indicator is temperature and altitude compensated. Designed to operate over temperature range of —55°C to +70°C. Rate of ascent of 20,000 fpm or descent of 30,000 fpm will not affect calibration. Dial graduations are expanded in low range for more accurate reading. Has stops at ends of indicating range to prevent errors in reading during rapid climbs or dives. Instrument weighs 1.2 lbs.

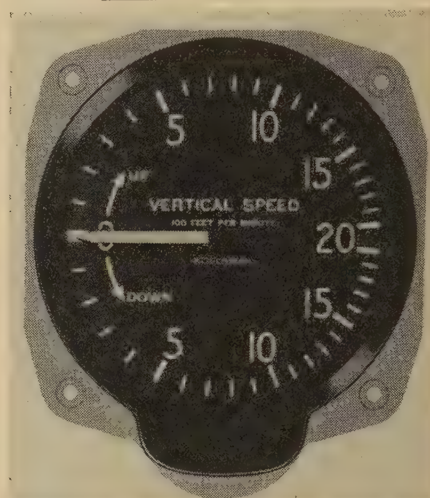


THOMAS A. EDISON, INC.
West Orange, N. J.

Model 195 Engine Gauge Unit combines in one case the three most important engine instruments: oil temperature indicator, oil pressure gauge, and vented fuel pressure gauge. Operates 14- or 28-volt DC. Case is equipped with removable bezel to facilitate replacement of cover glass in event of breakage.

KOLLSMAN INSTRUMENT CORP.
Elmhurst, N. Y.

Sensitive Altimeter is particularly designed for use under instrument flying conditions where accuracy is essential throughout wide ranges of pressures and temperatures. Accuracy of Sensitive Altimeter is reflected in open scale on which estimates within 10 ft. can be made. This one, Type 671CPX-01, is for use in pressurized aircraft. All Kollsman Sensitive Altimeters with the letter "P" in their type numbers are designed to withstand pressures up to 50 inches of mercury absolute. Range of altimeter: 0 to 50,000 ft. Zero setting from 28.10 to 31.00 inches of mercury absolute. Weight: 1 lb., 5.5 oz.



Vertical Speed Indicator Type 716 BK indicates rate of descent or ascent during landing, take-off, or traveling through an overcast. Is used as an aid in maintaining level flight. Range: 0 to 2,000 fpm. Altitude and temperature compensated. Weight: 1 lb., 3-1/2 oz.

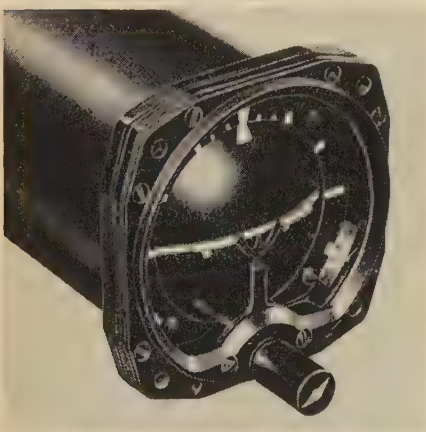
SAFE FLIGHT INSTRUMENT CORP.
White Plains, N. Y.

Landing Speed Indicator gives continuous indication of top portion of lift curve, providing direct continuous reading of the lift the wing is developing in relation to total lift available at any one instant. LSI also indicates safe take-off speed and attitude, best initial climb under all power and weight conditions, and provides instant information for optimum speed in event of power failure of multi-engine equipment. Three units comprise this System: Lift Detector, Lift Computer, Landing Speed Indicator.

Optimum Speed Indicator is further extension of LSI to provide direct indication of maximum range, endurance, and take-off climb (V_2). Selection among these functions, including those of LSI,

(Continued on Page 48)

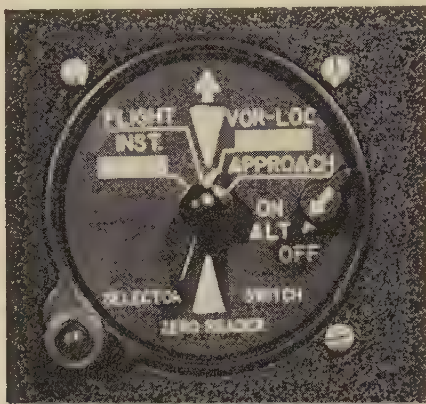
is made by selector switch which changes null correspondingly. Continuous null type presentation eliminates constant reference to manuals to learn proper speeds for momentary gross weights. Units comprising this System are similar to those of LSI System.



SPERRY GYROSCOPE CO.
Great Neck, L. I., N. Y.

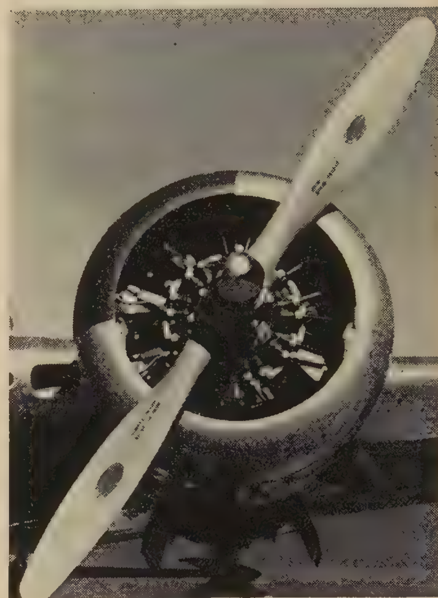
H-5 Gyro Horizon (Electric-Driven) operates on 115-volt, 400-cycle AC. Power Consumption: 140 watts maximum, starting; 18 watts maximum, running. Power factor: 0.7 Turn Error Compensation: Is compensated for turns having 20° bank angle at 300 mph TAS. Versatility: Provides accurate indications at temperatures ranging from —65°F to +160°F; meets all requirements of high-altitude flying. No caging mechanism is required as gyro cannot tumble. Operating Limits: Horizon bar indicates climbs and glides within limits of plus or minus 27°, and rolls through 360°. Weight: Indicator, 3-1/4 lbs.; Power Control, 2-1/2 lbs.

Zero Reader Flight Director is a gyroscopic flight and navigation instrument which takes the type of information usually supplied by the gyro horizon, directional gyro, magnetic compass, sensitive altimeter, and cross-pointer meter and gives it to the pilot on a two-element indicator in a form which tells him how to move the controls. Can be used as a manual standby for Gyropilot or as a means of efficient manual flying in aircraft not equipped with Gyropilot. Components are: Indicator, Heading Selector, Selector Switch, Control and Mount. An extra, for Zero Reader Z-2A System, is Radio Rate Unit which automatically computes for cross-winds during final approach. Power Requirements: 27.5-volt DC; 115-vott, 400-cycle AC. Altitude Range: 0 to 50,000 ft. Weight: Z-2, less cables and fittings, 28 lbs., 9 oz. Z-2A with Radio Rate Unit, 7-3/4 lbs. more than Z-2. Unless aircraft is already equipped, a Gyrosyn Compass is required.



C-2A Gyrosyn Compass combines functions of directional gyro and magnetic compass. Via a Flux Valve, the gyro is synchronized to the magnetic meridian, making instrument a gyro-stabilized compass that provides stable directional indication under all conditions of air turbulence. Does not drift; requires no resetting. Does not oscillate or have northerly turning error. Complete equipment consists of gyrosyn compass, flux valve and amplifier. Operates on 115-volt, 400-cycle AC; 28-volt DC. Weight: 3 lbs. Amplifier—2-1/4 lbs. Repeater—1-1/2 lbs.

Propellers



HAMILTON STANDARD DIVISION
Windsor Locks, Conn.

Model 22D30 is a Hydromatic propeller incorporating variable blade pitch and feathering. It has two duralumin blades, varies in diameter from 8 to 13 ft., is for engines of 600 hp (minimum except take-off), 2300 RPM (except take-off) and SAE 30 spline engine shaft. Model 22D30 is used on Beech D-18, etc. Slightly larger three-bladed version (23D40) is for Grumman *Mallard*.

Model 23E50 Hydromatic is for the DC-3, DC-4, B-26, PV-1 conversions, etc. It is a three-bladed (duralumin) model varying in diameter from 8 ft. to 15 ft. It incorporates automatic blade pitch and feathering; is hydraulic in action. Used for engines of 1625 hp (maximum except take-off), and 2100 maximum RPM (except take-off).

Model 2B20 Controllable-Counterweight propeller is available for Cessna 190, 195, etc. Is two-bladed (duralumin), varying in diameter from 6 ft. to 9-1/2 ft. Has hydraulically variable pitch and is for engines of 350 hp (except take-off), 2450 RPM (except take-off), and SAE 20 spline engine shaft.

FLOTTORP MANUFACTURING CO.
Grand Rapids, Mich.

Controllable-Pitch Propellers for Continental-powered (65 to 85-hp) aircraft are available from Flottorp. A hard erosion and water resistant plastic armor coating is now standard on Flottorp controllable-pitch props. This reduces blade maintenance and largely eliminates pitting and scoring from sand and gravel. Mechanical

control of controllable pitch propeller is Beech Roby design. Weight: Propeller (blades and hub)—27 to 31 lbs.; Manual Control—1.2 to 3.3 lbs. Prices: from $189 to $295.

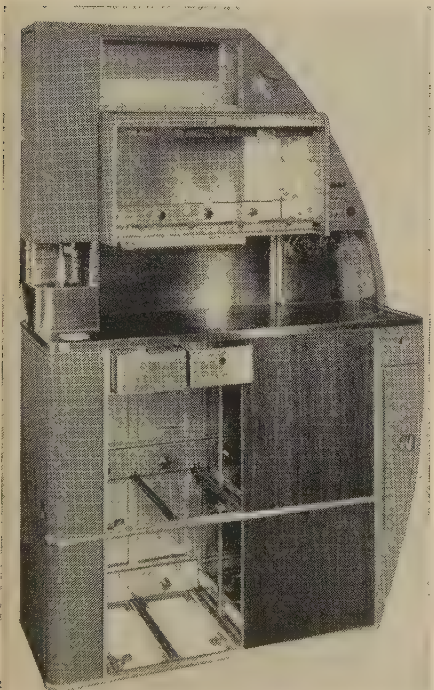
McCAULEY INDUSTRIAL CORP.
Dayton, Ohio

Met-L-Matic constant speed propellers feature rigid pre-load blade retention, completely enclosed and protected pitch changing mechanism and retention ball bearing separators. Inherent rigidity of blade assembly provides and maintains accurate balance and close tracking. A Woodward Model 210065 governor is required when the Met-L-Matic is used to replace a prop of the counterweighted type. This propeller is available for Continental, Franklin and Lycoming-powered aircraft.

HARTZELL PROPELLER CO.
Piqua, Ohio

Hartzell offers both constant-speed (governor-controlled) and full-feathering constant-speed propellers for busines aircraft. High-performing metal blades are combined with low-cost hub requiring minimum maintenance. Operation of pitch-changing mechanism is via oil pressure supplied by a governor mounted on engine. Feathering version may be feathered and unfeathered in the air with no auxiliary mechanism or power source required. Constant-speed, full-feathering Hartzell props are available for Aero *Commander*, Cessna Twin 310, Riley *Twin Navion*, Piper *Apache* and Grumman *Widgeon* Amphibian. Constant-speed medels are available for Cessna 180. Non-Feathering has pitch range of 24°; Feathering has pitch range of 70°.

Miscellaneous



WEBER AIRCRAFT CORP.
Burbank, Calif.

Buffet Assembly features walnut veneer sliding doors on lower structure, polished aluminum doors on upper structure, folding stainless steel counter top, water dispenser, refuse tank and refuse container, and am-

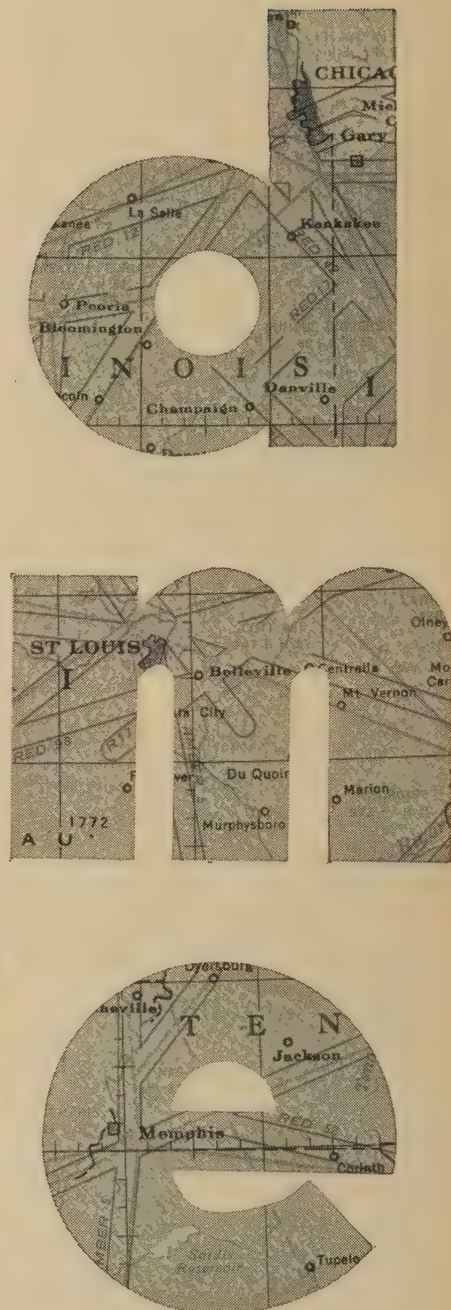
(Continued on Page 51)

FIRST

OF THE *Sapphire*

LINE OF NARCO PRODUCTS

narco



Positive, continuous indication of position is now a reality with the VOR/DME system, greatly simplifying navigation for safer, easier, faster, more precise, more economical flight operations.

To implement this final link in CAA's common system of VHF navigation, Narco introduces its Model UDI-1 Distance Measuring Equipment for commercial and corporate aircraft use.

Perfected after years of exhaustive development under CAA/ANDB sponsorship, this new Narco DME is built to full air transport standards and has many exclusive features such as crystal-tuning.

This fine, new airline-tested DME, introduces Narco's new Sapphire line of navigation and communications equipment designed to the highest possible electronic standards unsurpassed for reliability and performance.

choose *narco* DME for these superior points . . .

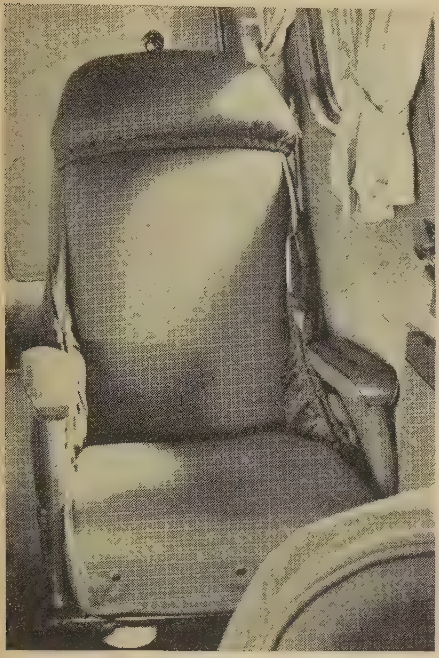
- **Exclusive crystal tuning**
- **Unitized construction for efficient servicing**
- **Backed by a nationwide network of especially-equipped DME service centers**

Weighing less than 33 pounds, Narco DME equipment consists of a remote unit mountable on a standard ½ ATR rack, a channel selector, and panel-mounted instrument which indicates distances in two ranges 0–200 miles and 0–20 miles.

narco

NATIONAL AERONAUTICAL CORP.
Ambler, Pennsylvania

ple space for miscellaneous stowage. It is equipped with electrical hot cups, hot liquid containers and hot food carriers. Exterior of this assembly is covered with pebble-grained vinyl. Weight: 193 lbs. Other models in varying sizes are available.



IRVING AIR CHUTE CO., INC.
Lexington, Ky.

Irvin Chair Chute offers parachute protection for cabin airplanes without passenger having to "wear" a chute. Chair chute fits into the back of the chair and is upholstered to match the rest of the seat. Chute itself is comfortable back rest; harness is tucked into the side of the chair, out of the way but instantly available. Irvin Chair Chutes also can be furnished with automatic opening release. Available for all types of cabin planes.

TECO, INC.
Burbank, Calif.

Seat Model TE 327 is a single-place sleeper-type swivel chair for executive aircraft. Permits 360° swivel through 15° increments of adjustment. TE 327 features leg extension, with foam rubber cushion and matching fabric, for sleeper use. Leg extension can be retracted out of the way into lower section of seat. Structure is Chrome-Moly welded steel tubing. Fabric, leather and plastic exterior finishes can be supplied to individual customer specifications. Weight: Approximately 55 lbs. This model is recommended for *Lodestar*, DC-3, A-26, B-15-type aircraft. Other model seats, divans, wall couches, pilot and copilot seats also are available.

HARDMAN TOOL & ENGINEERING CO.
Los Angeles, Calif.

Model 3004 Siesta swivel chair is one of a new line designed for the new Twin Beech Model 18 series. Custom-type luxury executive chairs, lounges, etc., are premium installations on business aircraft. In addition to a complete line of seats and furnishings, Hardman's products include map and data cases, report holders, etc.

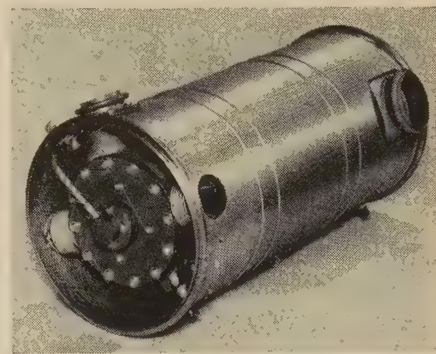
(Contiuned on Page 52)

BURNS AERO SEAT CO.
Burbank, Calif.

Specializing in the manufacture of seats, divans and lounges for executive aircraft, Burns Aero Seat Co. has developed innumerable styles and models. Are CAA Approved to TSO C25 specifications. To expedite planning and execution of executive interiors, Burns Aero has available a complimentary Executive Aircraft Interior Kit. Included for layout and specification purposes are fuselage blanks of various aircraft, descriptive photo layouts of seats, divans, lounges, upholstery detail sketches, executive brochures with layout suggestions, etc. This is available without charge to organizations interested in planning their own executive aircraft.

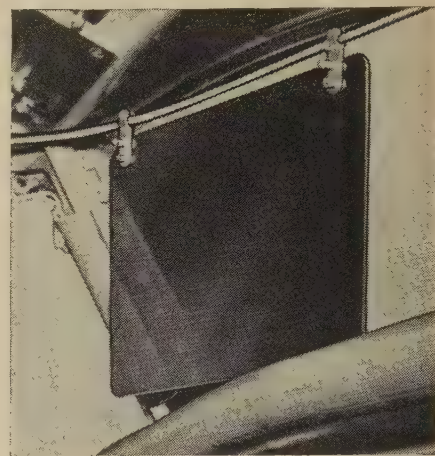
SURFACE COMBUSTION CORP.
Columbus, Ohio

Janitrol S-200 is a 200,000 Btu/hr aircraft heater, one of five different models in Janitrol's standard line of heaters for installation in business and executive-type aircraft. Others in the line are S-25, V-25, S-50 and S-100. Each can be used singly, in multiples or in combination for heating smallest or largest-type aircraft. Accessories and controls are available for system installation by modification centers.



HARDMAN TOOL & ENGINEERING CO.
Los Angeles, Calif.

Monorail Sun Visor, applicable to all cockpits, is made of Du Pont Acrylic Resin No. H-2503. The 8-1/2 x 11 inch visor is ultra-violet absorbent below a wave length of 3400-A on the spectrum, the spectral range causing most damage and discomfort to the human eye. Monorails and attachments are non-ferrous metals and, consequently, non-magnetic. The visor can be positioned anywhere in its respective area of the cockpit, and stows in a safety bracket when not in use.



Skyways Round Table

(Continued from Page 20)

normally would through a distributor."

Bob Durham: "As far as the government's policy is concerned, I think it's generally understood that they are concentrating on converting their overhaul facilities and maintenance bases to handle jet aircraft primarily, and there is an increasing tendency for them to farm out to commercial sources the reciprocating engines and their components."

F. L. Hine: *"We've been talking about service facilities in handling aviation customers; now let's get into the actual parts problem.*

"Mr. Mathey, what about the availability of parts for DC-3's or any other planes you handle?"

N. H. Mathey: "The availability of parts is one of our particular problems at Teterboro. Yesterday, there were 10 different *makes* of aircraft in our service hangar. At Atlantic, we have more than $130,000 tied up in parts inventory and yet we can't begin to touch the desires of our customers. Almost 50% of the time we're looking for parts that they need and that we do not have. If we covered the matter properly, we would probably have to have nearly a million dollars in inventory, and that wouldn't make sense in our size operation.

"We run into a lot of difficulty, particularly with the executive pilot who shops around the country. If he wants a generator, he'll check here . . . he'll check in San Francisco . . . . and he usually ends up buying it directly from some supplier and we're left completely out in the cold. Then, when the executive pilot comes face to face with what he considers a severe emergency and we haven't the part he needs, he thinks we're at fault. In other words, when we stock the part, he goes shopping for it all over the country; if we do not stock the part, he's unhappy because we don't have it. By buying directly from the supplier at either the same price we buy it or *even* cheaper, the executive pilot is cutting us out of business, and yet he needs us in order to maintain an efficient operation. Frankly, we feel that more cooperation on the part of the business pilot is definitely in order."

F. B. Woodworth: "That goes back to the point I made earlier that as aviation becomes a little more stabilized and the surplus market disappears, the manufacturers should be careful to set up their distributorships so that each one can do the proper merchandising job and still have a good share of the market."

N. H. Mathey: "I agree with you, Mr. Woodworth, but there's another point I'd like to bring out. The distributors need the service operators as an outlet for their sales. They can't possibly develop their own outlets at the same rate and know what is needed. Therefore, we'd like to call on the distributors to cooperate with us by *not* selling direct to the end user. The distributor should limit this kind of selling. He should realize that the fixed-base operator is an important cog in the wheel. If we do not have the fixed-base operator, there is going to be less flying. The pilots that do fly will have to carry more spare parts as well as mechanics to do the work."

H. J. Andrieu: "With reference to Mr. Mathey's comments on the distributor set-up, within our company we have a sales policy which protects the distributor. We sell direct to the government, direct to the manufacturers, direct to the airlines if they elect to buy from us, and direct to the distributors. Now, if an operator came to us to buy a generator, we would refer him to our distributor. In that way the distributor gets the benefit of the profit from the sale of the generator and he also provides whatever service may be required on the generator at some later date. We protect our distributors by not selling direct to end-users."

L. J. Bollo: "I'd like to carry that idea one step further. Speaking for Standard Aircraft, the distributor does try to sell the item, whatever it may be, through an authorized service station or fixed-base operator. If that continuity were maintained, all of us ought to be getting along all right. But if you inject surplus into this—and almost anybody can supply a surplus generator, for example—you'll find it's very hard to establish a sales pattern. We all hope that the surplus gets washed out of the market soon."

F. L. Hine: *"Do business-aircraft operators shop for this surplus equipment because of price . . . . or do they make such purchases because they do not know where to go to buy a specific unit?"*

Bob Durham: "From my experi-

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Skyways Round Table

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ence, the individual executive pilot has developed a tendency to shop. He will read magazines and newspapers to try to find something he wants on his aircraft and he will fly a DC-3 from New York to Buffalo, for example, to get a $15 instrument —all because he's been told that it will take from three weeks to two months to get it from a regular distributor. The pilot wants a particular item on his plane right away . . . . and he'll go to any expense to get it.

"Going back to what Mr. Lawrence said about General Electric's policy, I'd like to ask him a question: how are you going to service your equipment on executive aircraft except through a service organization or dealer who is known to the pilot?"

W. H. Lawrence: "We maintain aviation specialists in most of the regional districts of the U. S. Each one of those districts also has several service engineers qualified to handle aircraft apparatus. As far as I know, we haven't run up against this problem of the privately owned business plane requiring a great deal of service on our equipment. There are several companies in the area who overhaul our instruments and these companies contact our district offices. We supply them with parts and with our service bulletins to maintain that equipment. If they need field service, we will supply the service engineer to help them, if the instrument is within warranty, of course."

Bob Durham: "If it's beyond warranty, then what?"

W. H. Lawrence: "We will supply field service at the customer's expense. We've done service work in the field on quite a bit of equipment which was much older than the warranty, and the expense involved has been within reason."

F. L. Hine: *"Mr. Mettey, you are also going to run into that problem soon. Right now you may not have much of a distribution problem, but three or four years from now some of these technical developments you're working on for the military will find their way into the business aircraft market. I know that Hamilton Standard's policy is similar to GE's in that you handle new products directly with the consumer. But what are you going to do if the need for service on this equipment becomes widespread?"*

R. L. Mettey: "It is quite true that executive transports are using our latest equipment, not available on surplus, in increasing amounts. Parts are available from the factory direct or through our two distributors—Southwest Airmotive in Dallas, and Pacific Airmotive in California. Some private operators have contacted the factory for replacement parts for these aircraft because the distributors do not handle an adequate stock to satisfy their needs."

F. L. Hine: *"Apparently, there is no central source of information on the availability of parts. In other words, when the business pilot needs parts, he has to pretty well comb the U. S. I wonder if anyone here has any ideas on how we could help that situation. Maybe there should be one central source of information on the availability of parts for corporate aircraft."*

Bob Durham: "That's a good suggestion. Perhaps a directory which would be supplied to all pilots would be helpful to manufacturers and distributors as well as the service operators themselves."

F. L. Hine: *"To face the issue squarely, I think that would work perfectly for newly manufactured items that are readily available from recognized distributors or dealers, but how about Mr. Mathey's suggestion that he has 10 or 12 different aircraft in his hangar and along comes a pre-World War II model? There are no new parts that will fit his plane so he has to shop all over the country for various replacement parts. Eventually, he gets into the habit of shopping for surplus."*

Bob Durham: "That's a problem that the pilot is going to have to live with for awhile. Until there are more standardized models and greater production, it is going to be part of the responsibility of the fixed-base operator to know the sources for items, just as it has been for years in the automotive field. When an old jalopy is driven into a garage and there is no manufacturing source for parts, the garage man has to go to a junkyard or a surplus salvage operator.

"On the subject of surplus again, two gentlemen here expressed the hope that the surplus picture would soon be all washed up. I think we are going to have to reconcile ourselves to the fact that we are going to have to live with surplus for another five or 10 years. There are new waves of surplus being released right now."

F. B. Woodworth: "In the case of radio equipment, we have a problem that is different from the average airplane parts problem. Our products go into what is called a system. In other words, you don't ordinarily buy one item of equipment and expect it to work alone. It has to fit into some kind of system which the plane has . . . . and there are almost as many systems as there are airplanes. This means that the fellows who are doing the work on an airplane have to have a broad background of knowledge as to what equipment might be made to do a certain job as far as radio is concerned. This knowledge only comes from long association with the equipment. These fellows also have to know where sources for surplus equipment can be found and how to integrate that surplus into the system that is on the airplane. While we all hope that surplus equipment is on the way out, we will probably always have airplanes with some of it on them. The fortunate thing about the radio picture is that, between certain laws and certain pressures of channel availability and the natural state of flux that the aviation navigation and communication art is in, a lot of surplus gear is being forced out of the airplane. There aren't enough channels on the surplus equipment for VOR and/or VHF communications, for example. Therefore, most of the business-plane operators are looking to the day when they can install the most modern radio gear. They are trying to figure out which is the best way to do it. They live with the surplus gear for the time being, but eventually it's going to go."

F. L. Hine: *"The surplus market is probably one of the most pressing problems facing the aviation parts industry today. We, as distributors for certain lines, have heard manufacturers condemn the surplus market and remark how difficult it has made their problem of selling newly manufactured material. They usually further remark that when the surplus dries up, we will be on Easy Street again and will be able to provide the material that's needed. Yet, as Mr. Durham has brought out, we will probably have the surplus market with us for sometime to come because we have just gone through another little fracas overseas and the surplus is again beginning to show up."*

H. J. Andrieu: "In many instances surplus has helped the manufacturer as well as everybody else on non-current spares. It has provided an economical maintenance cost which the operator could not have had if we had been forced to manufacture a small quantity of non-current parts. We are running into considerable difficulty today in trying to provide non-current spares. We are trying to do it at a reasonable cost and we're having some amount of success. We

are not successful in all instances by any means, but we do try to keep our fingers on the pulse of the equipment being used, and our distributors are doing the same thing. We analyze our sales over a given period of time to see if we can initiate a production order in our shop that will result in a reasonable price to the ultimate user of any non-current part."

F. L. Hine: *"Just what is the status of the surplus market at this time?"*

L. J. Bollo: "It's my understanding that the governmental agencies are going to start to dump about $2,000,000,000 worth of aircraft material in what they term a 'spring housecleaning.' I hope it is done in a way that will not bother any of us too much, but up to this time I have been unable to find out exactly what the parts are that will be dumped on the market. I do not think anyone knows what percentage of the parts will be engines, accessories, instruments, etc. We as distributors are going to have to keep an eye on the situation because it will affect not only the distributor but the manufacturer as well."

F. L. Hine: *"Is the surplus market as strong as it was two years ago?"*

Tom Moore: "As far as I can see, the surplus market today is about as steady as it was two years ago. I don't really see any trend. However, I'm not in the surplus market, but I would like to back up Mr. Durham's statement that the surplus operator is going to remain in existence for another five or 10 years. I believe he will have to stay in existence for even a longer period of time than that. One specific example of why is the 1830-75 engine. I would guess that fully half of our business on commercial engine overhaul is with the 1830-75, and today we do not have a recognized prime manufacturer of the 1830-75. That was an engine which was designed by the prime manufacturer but not built by him, and because that engine is not recognized by the prime manufacturer, we are having a terrific problem. If it weren't for the surplus dealers, we would not be in business on that engine. Therefore, it seems to me the surplus dealer will be in business for quite a time, certainly as long as we have the 1830-75's around."

Bob Durham: "We have noticed an increasing number of lists of materials being offered for sale, and also numerous news releases that tell of a much larger quantity of material about to hit the market. A list I looked over just a few days ago showed many thousands of accessories in new condition being released by the Navy for bids. That list is just one of a stack that we get each week from airframe manufacturers and various depots for all types of material, from airframe down to the smallest rivet, screw or bolt."

F. L. Hine: *"Another problem I'd like to bring up is this matter of lead time in the procurement of replacement parts, in this case from a distributor angle. It affects the fixed-base operator and also the ultimate consumer. Although the situation has improved recently, it is still a problem with certain critical parts where you have your longest lead times from the manufacturers. Mr. Lawrence, is this going to be licked once and for all?"*

W. H. Lawrence: "The lead time should improve as the loads on the factory are reduced. Although we do not warehouse a great deal of electrical equipment, we normally warehouse enough to cover our lead time. However, our production is primarily military and, therefore, we have to continually watch that those items that are for commercial use are manufactured and the lead time kept within reason. It is something a manufacturer such as GE continually works to shorten. But the lead time on an item out of manufacture and in very small use, is still going to have long shipment."

H. J. Andrieu: "Our problem with lead time has lessened considerably in the past six months. Through our expanded facilities, we reduced lead time on many items to 90 days, 120 days, etc., depending on the item. A recent survey indicated that 42% of our commercial spare parts come right off our own shelves. We have a stockroom at Teterboro, N. J. and three other stockrooms around the country, one at each of our associate divisions. We find today that conditions are greatly improved."

F. L. Hine: *"Before we bring this meeting to a close, gentlemen, I'd like to call on everyone here for a short summarization of their feelings on this distribution problem. Mr. Durham, will you lead off again?"*

Bob Durham: "During World War II, the emphasis on aircraft production that created the rapid growth of this industry, put the industry about 20 years ahead of a normal peacetime growth, and it's going to be a good many years before the distribution end of the business can adequately measure up to the vacuum that was created during that rapid-expansion period."

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N. H. Mathey: "From today's discussion, it appears to me that the surplus dealer in aircraft parts is going to be here for some time, and he is going to serve a decided purpose. Therefore, it behooves us to develop the better surplus dealers in order to keep certain aircraft in the air with a minimum of difficulty and delay. Between the fixed-base operator and certain suppliers, I think we can do this and, at the same time, eliminate a lot of competition we are getting from end-users who purchase direct from surplus dealers."

L. J. Bollo: "Gentlemen, this discusion has been very educational to me. I've learned of the problems you other distributors and manufacturers have and I believe, aside from surplus, we are making progress as organizations. Deliveries which have given distributors a great deal of trouble in the past are much better on postwar products than on the surplus market as it exists today."

R. L. Mettey: "It appears that the executive-aircraft operator's problem is one with which he can help himself by dealing with a certain distributor and making his periodic needs known in advance so that the distributor can supply his requirements. In turn, the distributor can order from the manufacturers so they can better take care of the executive-transport picture. Too often intermittent orders come to a manufacturer for one or two seals, for example. Actually, the handling cost for such items exceeds the price of the parts. Consequently, we would rather see the executive-aircraft operator deal directly with the distributor for those pieces. At least, he should let his needs be known in advance so that such things as manufacturer's lead time can be absorbed."

Tom Moore: "Perhaps the biggest thing is the realization that the parts picture and parts problems are basic to aviation, whether it be in the aircraft field, the engines, equipment, radios, or other components. I think everyone here is cognizant of the fact that anything than can be done at any time to further a smooth-flowing parts picture would be helpful to all the industry."

H. J. Andrieu: "In summarizing, I would like to say that I believe the way to achieve maximum distribution of your products throughout the country is through a good distributor organization. The distributor has the welfare of the plane operator as well as the manufacturer at heart in trying to sell a manufacturer's products and maintain them. We have 12 distributors throughout the country, most of which are doing a very good job for us. We try to keep them supplied with the parts as they order them, and they are trying to maintain a good inventory so as to provide better service to the operators. I believe that is the way to do it, and we have found it to be a successful venture."

F. B. Woodworth: "The radio portion apparently is unique in that the surplus field will not have a big part to play from here on. The trend in radio and navigational equipment is to new systems, and you cannot load up with some of the older gear and expect to fly under all types of conditions as the new ground equipment is installed. The only thing that I feel must be stressed as far as the distributor is concerned is that radio servicing has to be done with a very high degree of perfection, otherwise the complicated equipment isn't worth carrying in the plane. Therefore, the investment and quality of personnel of the organization has to be geared to as high a standard as possible. Naturally, the bread and butter part of any service organization is the equipment which they can also sell. On that basis, the distributorships should be very carefully proportioned. It isn't possible to have a large number of high-qualtiy organizations and have all of them stay alive, at least not until the aviation industry gets a lot bigger than it is today."

W. H. Lawrence: "As a manufacturer, we take the parts picture very seriously. When we manufacture our various equipment and sell it through an already existing and quite large sales and field organization, we try to keep in touch with the users of the equipment so that our factory can anticipate the supplying of the proper number of parts we know will be used. However, if the equipment becomes quite old, the supplying of parts becomes a big problem and so we have, more or less as a policy, run into an obsolescence program in which we declare obsolete that material which is old and for which supplying parts is practically impossible. In many instances the surplus market probably comes into play in this field. We keep a close watch on it and if it becomes necessary to shift our field organization or to expand, we are ready to do it."

F. L. Hine: *"Gentlemen, this has been a most informative and interesting meeting, and I would like to express my thanks to all of you for your participation and excellent contributions. At your behest, I should also like to thank SKYWAYS for enabling us to have this discussion period and the help it affords in finding solutions to our mutual problems."*

Ground Effect

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is a tendency for the air to flow off the wing tips in a vortex with a flow upward around the wing tip and then around and down in a backward direction as shown in *Figure 2.*

The greater the angle of attack of the wing, the stronger the lift coefficient and, consequently, the stronger the vortex and downflow of air behind the wing, and therefore the greater the drag resulting in the generation of these vortices. It has been shown mathematically that the induced drag coefficient for any angle of attack is equal to the lift coeffi-

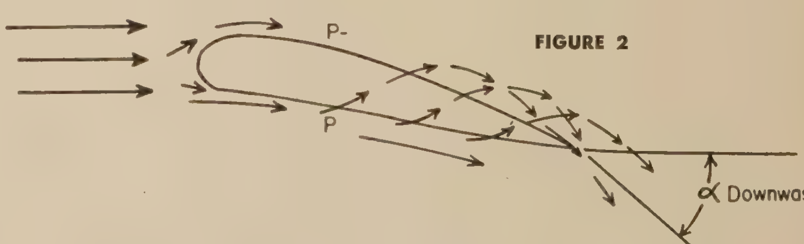

FIGURE 2

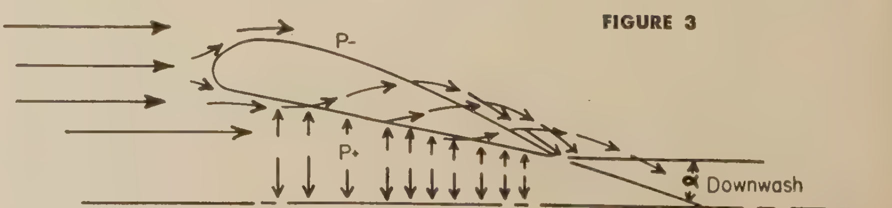

FIGURE 3

cient squared for that angle divided by 3.1416 times the aspect ratio of the wing.

$$Cdi = \frac{Cl^2}{\pi AR}$$

Notice what would happen if we had a very high aspect ratio wing of say 20. The induced drag coefficient would become small in comparison to that for a lower aspect ratio wing of 6. Nature figured this out long ago for the long-range seabirds that have high aspect ratio wings and can fly great distances with less effort that they could with wings of lower aspect ratio, such as those of a sparrow.

Now let us take our wing section of *Figure 2* and put a ground boundary below it, as shown in *Figure 3*.

Notice that the deflection of air is much less in *Figure* 3. Due to the ground boundary preventing the large angle of downflow as in *Figure* 2, energy imparted toward deflecting the air downward becomes less and, therefore, the induced drag is reduced. Also, a greater positive pressure is built up under the wing due to compression of the air next to the ground which explains the increase in the lift coefficient due to ground effect.

Herein lies the secret of ground effect. The nearer the wing is to the ground, the less is the induced drag and the greater is the lift for a given angle of attack. It becomes apparent how birds make use of ground effect, and how an airplane wing is affected. Ground effect does not show material benefit until the wing is operating at a distance within a half span of the wing to the ground. It is conceivable that aircraft with considerable wing span could increase their ranges on long overseas flights by flying close to the water, although such practice would be tedious for the pilot and certainly would not apply to jet aircraft which have to operate at high altitude for economy.

Let us now examine a *THPr* (Thrust Horsepower Required) curve for a wing alone without ground effect. We will assume a wing carrying a given load at sea level. It would look like the curve presented in *Figure 4* where the thrust horsepower is plotted vertically and the airspeed of the wing horizontally.

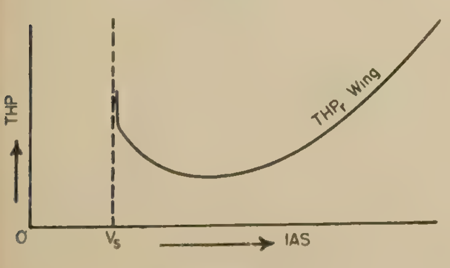

FIGURE 4

The *THPr* curve of *Figure 4* is a summation of the induced *THPr* curve and the profile *THPr* curve shown in *Figure 5* which, when added together, result in the *THPr* total curve (shown as a dotted line) and which is the same as the curve of *Figure 4*.

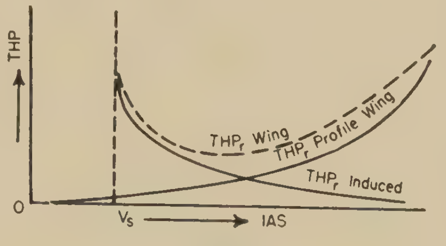

FIGURE 5

Now let us see what happens to the power-required curve for a wing when influenced by ground effect. First of all, we know that the induced drag is reduced which would modify the induced *THPr* curve of *Figure 5* to that of *Figure 6*.

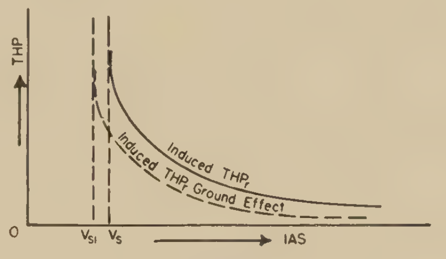

FIGURE 6

The *THPr* curve for wing profile drag would remain the same so the addition of the induced *THPr* curve with ground effect in *Figure 6* to the profile *THPr* curve of *Figure 5* would give a total *THPr* curve, shown in *Figure 7* as a dotted line, and reduced from the solid line which is the *THPr* curve for the wing without ground effect.

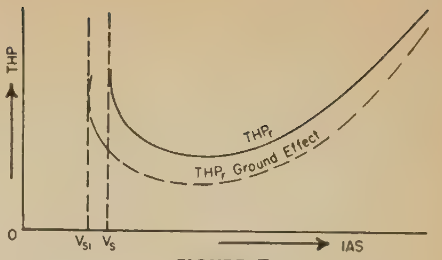

FIGURE 7

Note in *Figure 7* that not only is the power required for flight less, due to ground effect, but that also the stall speed is reduced. This is obvious, of course, due to the increased lift coefficient which is obtainable with ground effect and which can be seen readily in *Figure 1*. Because of this fact, it is possible to pull a plane off the ground at a speed lower than the actual stall speed of the plane in free flight. It also explains the tendency of planes to skip over the ground on take-off when they are airborne too soon.

Now that we have the power-required curves for a wing for both free flight and ground effect, some interesting facts can be revealed by adding to the curves of *Figure 7* a Thrust Horsepower Available (*THPa*) curve as shown in *Figure 8*.

The *THPa* curve in *Figure 8* has been drawn to represent a very underpowered wing configuration or a multi-engined configuration which has lost considerable power due to engine failure. It has been drawn such that for a wing without ground effect, there is little differential of *THP* to provide for much rate of climb between points *A* and *C*. There is positive performance though where the maximum amount is represented by BB′, the *THP* differential between the *THPa* curve and the *THPr* curve for the wing without ground effect.

Notice what happens to points *A*

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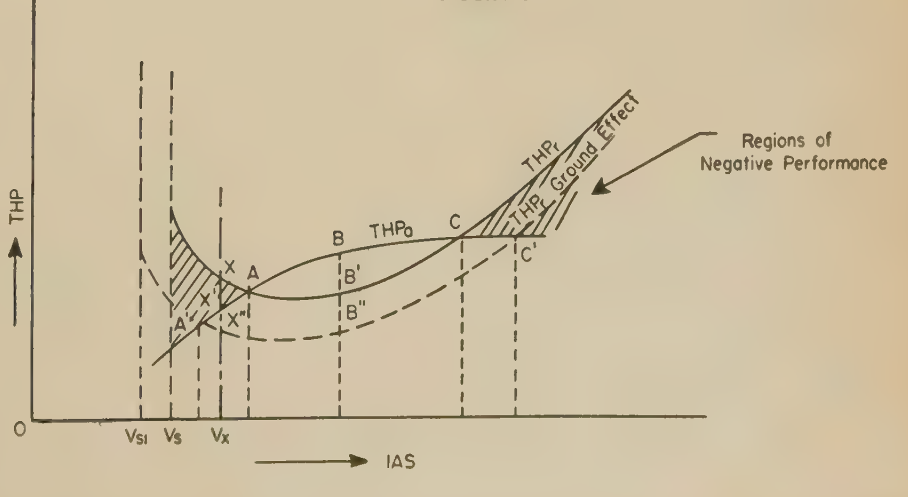
FIGURE 8



Ground Effect

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and C when the wing is operating close to the ground. Since the *THPr* curve is lowered, the *THPa* curve crosses the *THPr* curve with ground effect at A' and C' where A' is at a lower airspeed and C' is at a higher airspeed.

Between points A' and C' now, positive performance exists and at the maximum point BB″ it is considerably greater than BB' giving greater rate of climb due to ground effect. Of course, as the wing is climbed away from the ground boundary, the differential BB'' would rapidly reduce to BB' and the wing would then be operating on curve $A\ B'\ C$ where less rate of climb would be available. This would explain to some pilots, particularly of the early days of flying when underpowered planes were common, why their aircraft might take-off all right after considerable ground run, but then after climbing a few feet, cease climbing and remain at that height or even come back down again. This would have been particularly true during the heat of the day when engine performance could be reduced to the point where the power available for flight was very little more than the power required for flight without ground effect.

Another interesting fact evident from *Figure 8* is the condition where an aircraft could be pulled off the ground too soon on take-off and then be climbed away from the ground at an airspeed which could result in the aircraft entering a negative-performance region. In this region the power required for flight would become greater than the power available for flight and the aircraft could no longer remain in the air. This would result in the aircraft flying on the back side of the power required curve. Take for example section $xx'x''$ in *Figure 8* which has a corresponding airspeed Vx. If the aircraft were pulled off the ground at airspeed Vx, a positive performance differential x′xx″ would exist due to ground effect which would allow the aircraft to climb momentarily. However, if airspeed Vx were not increased and the aircraft climbed away from ground effect at airspeed Vx, a new set of conditions would be encountered where the aircraft, still at airspeed Vx, would be flying at point x on the *THPr* curve without ground effect. Point x, however, requires more *THP* than is available now at x' on the *THPa* curve and the aircraft would be flying in a negative-performance region. The aircraft would be unable to continue flight since if altitude were held, the speed would drop until stall occurred. The only possibility of flight remaining would be to dive gently toward the ground in order to get back into the ground effect and positive-performance region where speed could be built up to a value higher than Vx and then flight eventually continued by getting into a positive-performance region between points A and C. Such flying technique would demand an unusual amount of skill and probably more runway or unobstructed area than would normally be available to the pilot.

Although a rather theoretical presentation has been covered with respect to ground effect, some practical applications have been presented which are important in the operation of aircraft. These practical considerations are particularly applicable to larger aircraft and may be appreciated by the pilot flying multi-engined propeller or jet aircraft. For instance, take the case of a large hypothetical four-engine propeller-driven aircraft in overseas operation. Suppose a couple of engines were disabled so that with the remaining power the aircraft could not maintain level flight and was descending slowly at about 100 feet per minute with METO power on the two good engines. Assuming a descent speed of 120 mph, Cl of 1.2, Aspect Ratio of 8, and a wing area of 2,000 square feet, the induced drag in pounds at sea level would be 4,225 lbs—from the preceding formulas in this article:

$$Cdi = \frac{Cl^2}{\pi AR} = \frac{1.2^2}{3.141\text{x}8} = .0573$$

$$Di = Cdi\ \frac{\rho SV^2}{2} = .0573 \times .002378 \times 2000 \times \frac{176^2}{2} = 4225\ \textit{lbs.}$$

The power required for the induced drag alone (not including parasite drag for the wing, fuselage, tail, etc.) would be:

$$\frac{\textit{Drag} \times \textit{Velocity}}{550} \ \textit{or}\ \frac{4225 \times 176}{550} \ \textit{or}\ 1350\ \textit{THP}$$

where velocity is converted to feet per second. With propeller efficiencies of say .85, 1590 BHP would be required. Assuming a weight of 95,000 lbs., our deficit in power would be

$$\frac{95000 \times 100}{33000} \ \textit{or}\ 288\ \textit{THP from the formula}\ Rc = \frac{\textit{Excess THP} \times 33000.}{\textit{Weight}}$$

Dividing the deficit of 288 by .85, we would need an additional 339 BHP to just maintain flight. However, as a last resort, the aircraft might be flown within half a span from the water which might reduce the induced drag by as much as 30%, and consequently reduce the induced *THPr* from 1350 to 945 *THPr*. We would then recapture 405 *THP* which would more than overbalance the 288 *THP* deficit, giving a small positive performance. Instead of ditching the aircraft in mid-ocean, it might be flown to shore and even landed safely.

The foregoing condition may be explained more clearly by referring to *Figure 9* which shows a solid line *THPr* curve with a solid line *THPa* curve below it which does not cross the *THPr* curve at all, indicating negative performance. However, the *THPa* curve with ground effect at points A and C, giving a maximum positive differential $B'\ B''$ which allows a slight rate of climb, or enough performance to maintain level flight close to the surface.

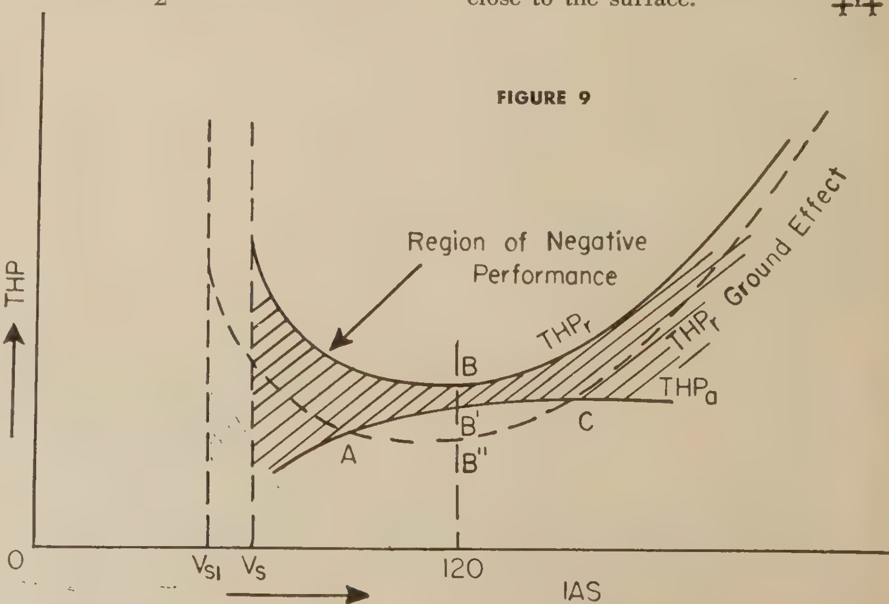

FIGURE 9

Piper Apache

(Continued from Page 11)

VHF transmitters with a total of 20 channels; a marker beacon receiver; and an ILS runway localizer feature. There is room for additional radio equipment on the panel. The Super Custom will include an autopilot.

With standard equipment of three radios and six external antennas, plus space for any additional aids a user may desire, the *Apache* will provide excellent cross-country utility. However, it is a light twin and as such it should not be called on to provide the type of performance expected of heavier twins in heavy turbulence or anything worse than average IFR conditions.

The *Apache*, like mots other aircraft, has landing characteristics all its own but, if adequate airspeed is maintaiend, they will pose no serious problems.

It should be remembered that, when the throttles are pulled way back, the propellers go from forward to neutral thrust and the result is always relatively high drag.

Without adequate airspeed, particularly when the gross load is 3,000 or better, the controls do not respond well after throttles are cut just before touchdown. The nose won't come up. There are two effective methods of bringing in the *Apache*. One is to keep power on until the moment before the wheels touchdown. The other is to maintain a high, steep glide angle. Each technique provides the necessary airspeed and when the throttles are pulled, you've got something left.

We flew No. 3 airplane, which did not incorporate some of the modifications planned for the production *Apache*. For example, the interior window trim showed a tendency to pull away from the frame, but Howard Piper reported that the plastic is being replaced by more sturdy material. The cabin ceiling light is being moved forward to provide better lighting for the panel and for the pilot when he wants to refer to a chart. The instrument dials are well lighted for normal night flying.

The interior of the cabin is roomy and the seats are built of foam rubber cushions, no-sag springs, and covered with leather and broadcloth fabrics. The sound level is good, stemming from tight sealing of doors and windows and fiberglass soundproofing material. The windows are crowned to prevent drumming.

The *Apache* also is a rugged airplane. The forward part of the fuselage is reinforced with steel tubing

(Continued on Page 64)

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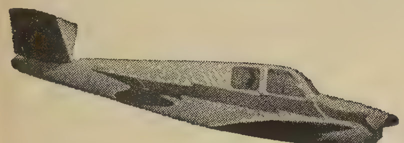

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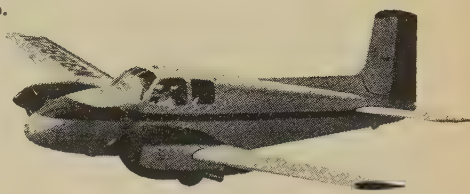

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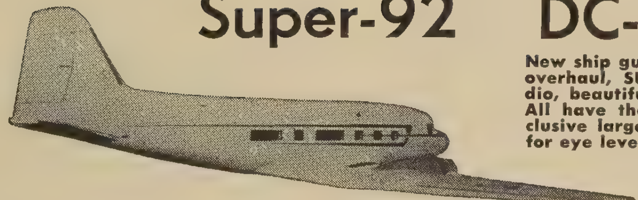

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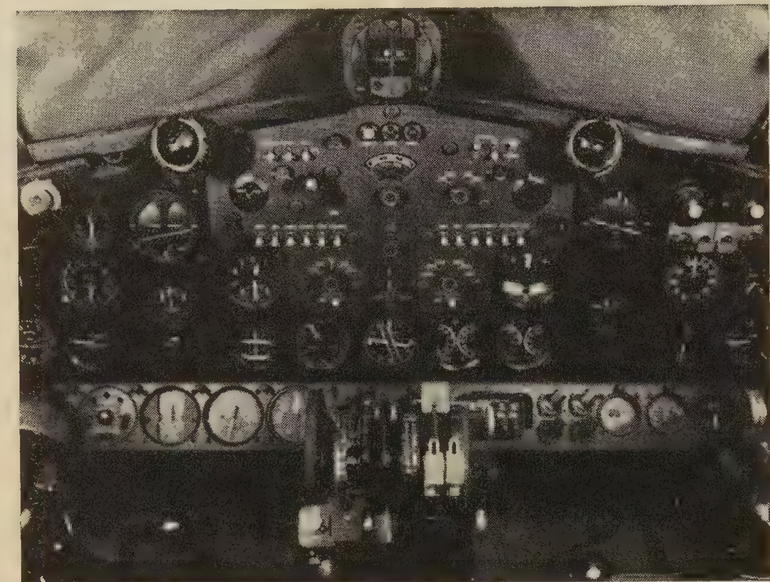

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Total airframe time: 14810 hours
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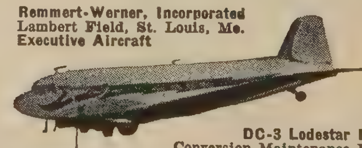

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Piper Apache

(Continued from Page 59)

to withstand high loads imposed on the center section. The wing structure comprises a massive stepped-down front spar, a rear spar, lateral stringers, ribs, stressed skin sections and a detachable wing tip. Flush riveting is used in most areas.

Electrol manufactures the *Apache* landing gear units, which are of the rugged airoil type with long oleo travel to smooth things out on rough airport surfaces. There is a hydraulic cylinder at each leg, actuated by fluid pressure from the engine-driven pump. Retraction is fast (11 seconds), and there is a manual hydraulic pump on the control pedestal. If hydraulic pressure is lost, the main gear automatically comes down and locks in place.

Particularly attractive to many users will be the cargo capacity. The baggage compartment is easy to get at through a door on the right side of the fuselage just back of the trailing edge of the wing and it supplies 25 cubic feet of space. It takes about two minutes to remove the rear seat in the cabin and to convert the airplane into a freighter with 80 cubic feet of unobstructed space. The main door can be quickly disconnected to facilitate loading.

The fuel system is comparatively simple. There are two 36-gallon rubber fuel cells in the wing and they are equipped with engine-driven pumps. Each line also has an electric pump for use in event of engine-pump failure. A cross-feed line makes it possible to feed fuel to the engine with either type of pump functioning. In fact, any of the four pumps can deliver fuel to both engines.

Maintenance on the *Apache* is simplified by the fact that the airplane really sits down low, and high ladders and maintenance fixtures are unnecessary, except for any work which might be done on the tail structure. The quick-disconnect access doors on the cowling are big enough to expose virtually the entire engine. About the only negative angle on this low-sitting low-wing aircraft is that the propellers pick up dents and nicks during taxi runs on gravel.

Because the *Apache* offers twin-engine reliability, with single-engine dependability, and because it is priced within the range of many companies to whom initial cost is vitally important, I'll venture to predict that this aircraft will play an important role in advancing the rapid progress of business aircraft usage.

SPECIFICATIONS
Model PA-23 Apache

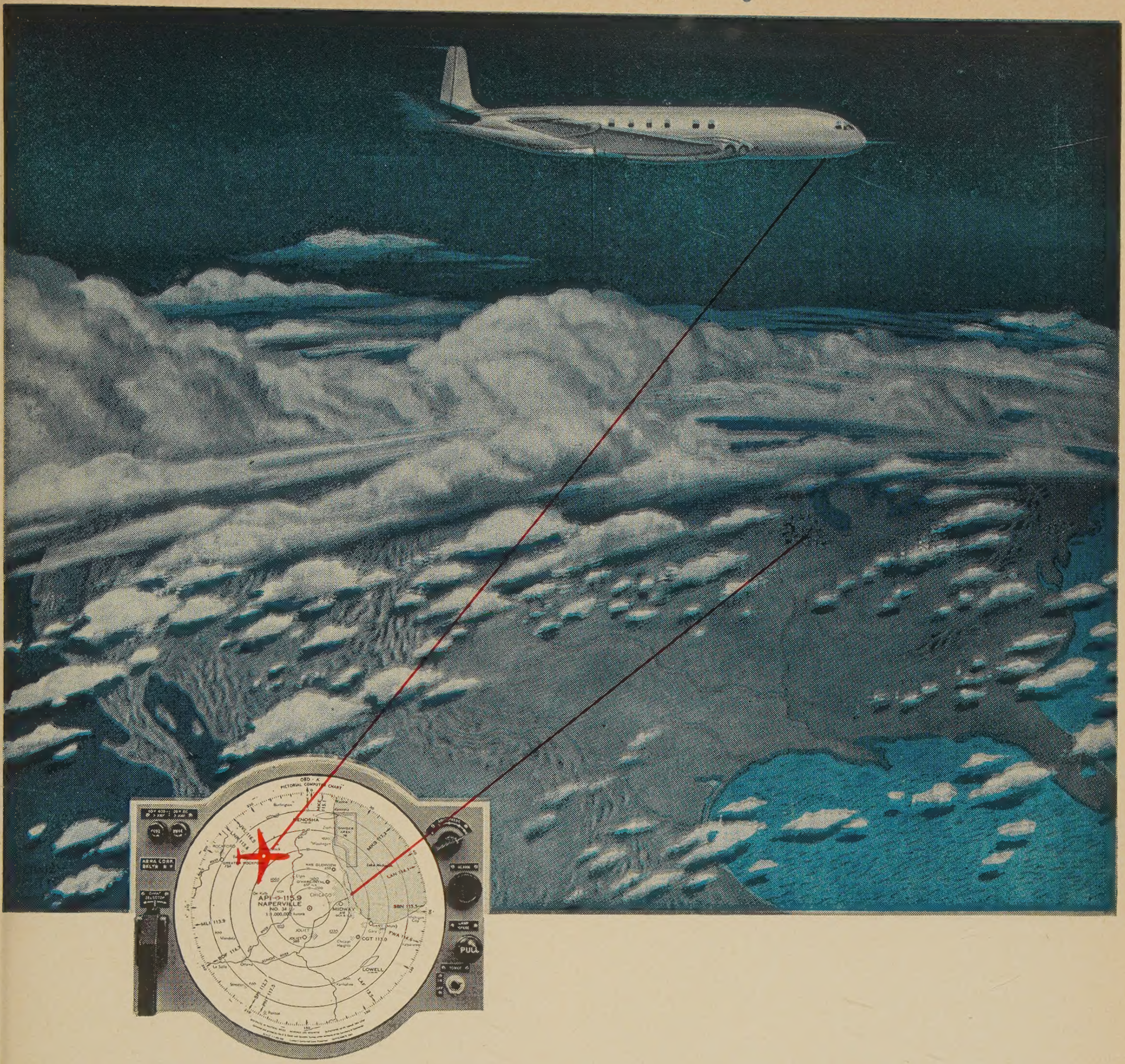
Engines (2) Lycoming		0-320
HP and RPM		150 @ 2700
Gross Weight		3500 lbs.
Empty Weight (Custom)		2158 lbs.
Useful Load:		
Passengers (4)	680 lbs.	
Fuel (72 gal.)	432 lbs.	
Oil (16 qt.)	32 lbs.	
Baggage	200 lbs.	
	1342 lbs.	
Wing Span		37 ft.
Wing Area		204 sq. ft.
Length		27.1 ft.
Height		9.5 ft.
Power Loading		11.7 lbs./hr.
Wing Loading		17.2 lbs./sq. ft.
Baggage Capacity		200 lbs. max.
Baggage Compart. Space		25 cu. ft.
Cargo Space (seat out)		80 cu. ft.
Fuel Capacity		72 gal.
Wheel Base		7.3 ft.
Wheel Tread		11.0 ft.

(Specifications supplied by Piper Aircraft Company)

TOTAL OPERATING COSTS AT VARIOUS ANNUAL HOURLY USAGE USING A 25% DEPRECIATION RATE

Annual Hours	300	400	500	600	800	1,000
Direct Hourly Cost	$11.01	$11.01	$11.01	$11.01	$11.01	$11.01
Annual Indirect Hourly Cost	35.16	26.37	21.10	17.58	13.19	10.55
Total Hourly Cost	46.17	37.38	32.11	28.59	24.20	21.56
Cost per Mile at 162 mph block to block	28.5¢	23¢	19.8¢	17.6¢	14.9¢	13.3¢
Miles Flown Annually	48,600	64,800	81,000	97,200	129,600	162,000

PIPER *arrives at total direct operating cost of $11.01 as follows: Gasoline, 16.3 gph at 35¢ and oil consumption (including 25-hour change), $6.21; Inspection, maintenance (including 25-, 100-hour and parts) $2.40; Reserve for engine and prop overhaul at minimum time recommended by manufacturer (750 hours), $2.40.*



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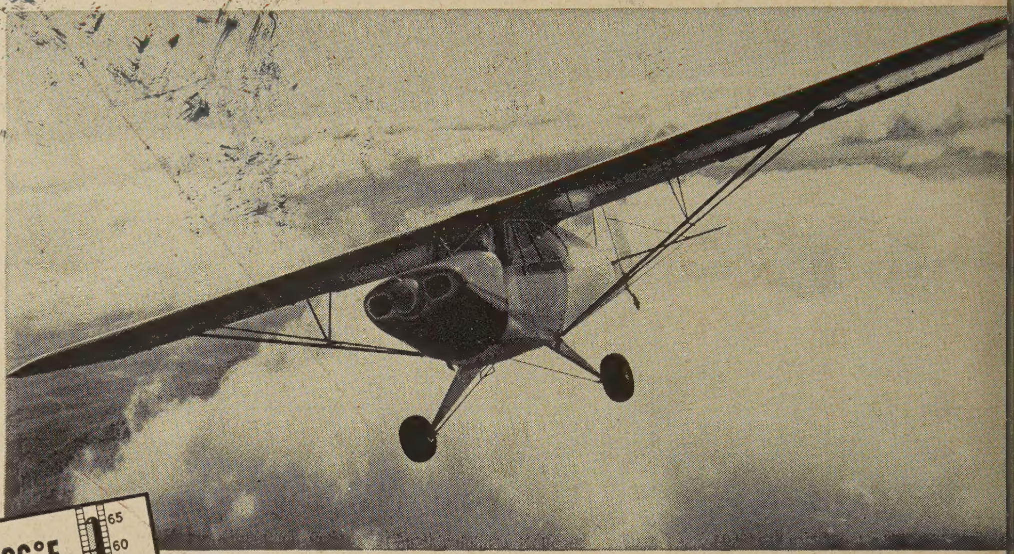
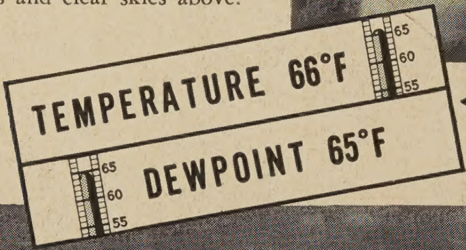


Encountering thin, patchy stratus about 900 feet in late afternoon, be on guard for rapid increase in cloud cover and lowering of base, especially with steady southerly winds and clear skies above.



← **Learn the significance** of "Spread"! The less the difference between Air Temperature and Dew Point Temperature—the greater the risk of fog. Don't trust spreads less than 5° F. at night.

In general, in estimating fog conditions, expect no ceilings wit winds less than 5 m.p.h. Expect a ceiling when winds are 10-3 m.p.h. An important exception may occur when sea fog blo inland over a cold land mass with strong winds and near zero ceilir

When destined to a coastal airport, pick an inland alternate, especially in spring when the water is still cold and may cool an onshore wind to the dew point.

Air Temperature....60° F.	NO FOG	Air Temperature....60° F.	FOG
Dew Point............55° F.		Dew Point............55° F.	
Water Temperature 58° F.		Water Temperature 50° F.	

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